

MANTLE

A Finite Element Program for the Thermal-Mechanical Analysis of Mantle Convection

APPENDIX E

Program Listing

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by

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OVERLAY(FLOW,0,0)
C
C
C*****
C
C      THE FOLLOWING VALUES REPRESENT THE MINIMUM DIMENSIONS
C      OF THE ARRAYS USED IN MANTLE.  THE SYMBOLS $AA$, $BB$,
C      ETC. MUST BE REPLACED BY INTEGER VALUES.  THE SYMBOLS
C      IDA, IDB, ETC. ARE FORTRAN VARIABLES THAT ARE USED IN
C      THE PROGRAM TO CHECK FOR ARRAY OVERFLOW.
C
C
C      $AA$ = IDA = NUMTP, WHICH MUST BE GREATER THAN NUMVP
C      $BB$ = IDB = NUMTP OR NUMVP+NUMPP, WHICHEVER IS GREATER
C      $CC$ = IDC = NUMVP
C      $DD$ = IDD = NUMPP
C      $EE$ = IDE = 6+NUMPP
C      $FF$ = IDF = NELMT
C      $GG$ = IDG = NELMC
C      $II$ = IDI = MAXIMUM IELEX
C      $JJ$ = IDJ = MAXIMUM LISTX
C      $LL$ = IDL = KMAX
C
C*****
C
C      PROGRAM DRIVE
C      1(TAPE5,OUTPUT,TAPE6=OUTPUT,TAPE7,TAPE1,TAPE2,TAPE3,TAPE4,TAPE8,
C      2 TAPE9)
C
C      COMMON/C1/
C      1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
C      2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TQ($AA$),
C      3 COSXXP($CC$),NPBC($AA$),NP($FF$,$EE$)
C
C      COMMON/C2/
C      1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
C      COMMON/C3/
C      1 IELE($II$),NPR($BB$),LIST($JJ$),MOVE($JJ$),INTO($JJ$),
C      2 IDIAG(2,$JJ$)
C
C      COMMON/C4/
C      1 KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
C      2 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
C
C      COMMON/C5/
C      1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C
C      DIMENSION
C      1 IFLOW(5)
C
C      DATA IDA,IDB,IDC,IDD,IEE,IDF/$AA$,$BB$,$CC$,$DD$,$EE$,$FF$/
C      DATA IDG,IDI,IDJ,IDL/$GG$,$II$,$JJ$,$LL$/
C
C      NTPE=6
C      NVPE=6
C
C
C

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```

C      WRITE(6,3)
C
C      WRITE(6,1)
C      READ(S,2) (IFLOW(I),I=1,3)
C      WRITE(6,2) (IFLOW(I),I=1,3)
C
C      IF(IFLOW(1).EQ.1) CALL OVERLAY(4HFLOW,1,0)
C      IF(IFLOW(1).EQ.2) CALL OVERLAY(4HFLOW,2,0)
C      IF(IFLOW(2).EQ.1) CALL OVERLAY(4HFLOW,3,0)
C      IF(IFLOW(3).EQ.1) CALL OVERLAY(4HFLOW,4,0)
C
C      IF(IFLOW(1).NE.7777) GO TO 7777
C
C      CALL MAP
C      CALL POINT
C      CALL VECTOR
C      CALL LINE
C      CALL FRAME
C
C 7777 STOP
C
C      1 FORMAT(10H0      IFLOW  )
C      2 FORMAT(8I10)
C      3 FORMAT(110H0*****I*****
C      1*****
C      1***** DATA FROM DRIVE  )
C
C      END

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```

OVERLAY(FLOW,1,0)
PROGRAM MESH1
C
C
COMMON/C1/
1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TQ($AA$),
3 COSXXP($CC$),NPBC($AA$),NP($FF$,$EE$)
C
COMMON/C2/
1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
COMMON/C5/
1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C
DIMENSION
1 RADIUS(49)
C
DATA IDQ/49/
C
C
C
WRITE(6,26)
C
C
READ AND INITIALIZATION OF DATA
WRITE(6,20)
READ(5,21) NPPE
WRITE(6,27) NPPE
C
IF(NPPE.NE.0.AND.NPPE.NE.1.AND.NPPE.NE.3) GO TO 7005
C
C
C
C
NVPE=4
NTPPE=6
NNPPE=6+NPPE
C
C
WRITE(6,2)
READ(5,3) RI,RO,RM,RPI
WRITE(6,3) RI,RO,RM,RPI
C
XMIN=-RO*1.01
XMAX=RO*1.01
YMIN=-RO*1.01
YMAX=RO*1.01
C
WRITE(6,18)
READ(5,19) IPUNCH
WRITE(6,19) IPUNCH
C
C
WRITE(6,7)
READ(5,1) NDIPTH,NDIVR
WRITE(6,1) NDIPTH,NDIVR
C
C
WRITE(6,9)

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```

      READ(5,10) NPBCI,XBCI,YBCI,TBCI
      READ(5,11) CHI,CXI,CYI,TXI,TYI,TQI
      WRITE(6,29)NPBCI,XBCI,YBCI,TBCI,CHI,CXI,CYI,TXI,TYI,TQI
      READ(5,10) NPBCO,XBCO,YBCO,TBCO
      READ(5,11) CHO,CXO,CYO,TXO,TYO,TQO
      WRITE(6,30)NPBCO,XBCO,YBCO,TBCO,CHO,CXO,CYO,TXO,TYO,TQO

C
C
C
C
      CALCULATE NUMBER OF NODAL POINTS

      NUMEL=NDIVTH*NDIVR*2
      NUMVP=(2*NDIVTH)*(2*NDIVR+1)
      NUMPP=0
      IF(NPPE.EQ.3) NUMPP=NUMVP-(NDIVR)*(NDIVTH+1)
      IF(NPPE.EQ.1) NUMPP=NDIVR*NDIVTH
      NELMC=NUMEL
      NELMT=NUMEL
      IF(RPI.EQ.2.0) GO TO 160
      NUMVP=NUMVP+2*NDIVR+1
      IF(NPPE.EQ.3) NUMPP=NUMPP+NDIVR
160  CONTINUE
      NUMTP=NUMVP
      NUMNP=NUMVP+NUMPP

C
C
      IF(NUMVP.GT.IDA.OR.NUMVP.GT.IDC) GO TO 7001
      IF(NUMNP.GT.IDB) GO TO 7002
      IF(NUMPP.GT.IDE) GO TO 7003
      IF(NUMEL.GT.IDF.OR.NUMEL.GT.IDG) GO TO 7004

C
C
      IEND=NUMVP
      IF(NUMTP.GT.NUMVP) IEND=NUMTP
      DO 280 I=1,IEND
        NPBC(I)=1
        COSXXP(I)=1.0
        XBC(I)=0.0
        YBC(I)=0.0
        TBC(I)=0.0
        CHI(I)=0.0
        CX(I)=0.0
        CY(I)=0.0
        TX(I)=0.0
        TY(I)=0.0
        TQ(I)=0.0
        XORD(I)=-0.0
        YORD(I)=-0.0
280  CONTINUE

C
C
      CALCULATE N.P. COORDINATES AND B.C.

      R=NDIVR*2
      DX=1.0/R
      X=0.0
      IEND=NDIVR*2+1
      DO 250 I=1,IEND
        RADIUS(I)=2.0*(X-0.5)*(X-1.0)*RI-4.0**X*(X-1.0)*RM+2.0**X*(X-.5)*RD
        X=X+DX
250  CONTINUE

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C      PI=3.141592654
      THETA=PI/2.0
      R=2*NDIVTH
      DTHETA=-RPI*PI/R
C
      IEND=2*NDIVTH
      IF(RPI.NE.2.0) IEND=IEND+1
      JEND=2*NDIVR
      ID=NDIVTH*2
      IF(RPI.NE.2.0) ID=NDIVTH*2+1
C
      DO 350 I=1,IEND
      NPI=I
      C=COS(THETA)
      S=SIN(THETA)
      POM=1.0
      IF(S.LT.0.0) POM=-1.0
C
      XBC(NPI)=XBCI*POM
      YBC(NPI)=YBCI*POM
      TBC(NPI)=TBCI
      CH(NPI)=CHI
      CX(NPI)=CXI*POM
      CY(NPI)=CYI*POM
      TX(NPI)=TXI*POM
      TY(NPI)=TYI*POM
      TQ(NPI)=TQI
      COSXP(NPI)=C*POM
      NPBC(NPI)=NPBCI
      XORD(NPI)=RADIUS(1)*C
      YORD(NPI)=RADIUS(1)*S
C
      DO 340 J=2,JEND
      NPI=NPI+ID
      XORD(NPI)=RADIUS(J)*C
      YORD(NPI)=RADIUS(J)*S
340  CONTINUE
C
      NPI=NPI+ID
      XBC(NPI)=XBCO*POM
      YBC(NPI)=YBCO*POM
      TBC(NPI)=TBCO
      CH(NPI)=CHO
      CX(NPI)=CXO*POM
      CY(NPI)=CYO*POM
      TX(NPI)=TXO*POM
      TY(NPI)=TYO*POM
      TQ(NPI)=TQO
      COSXP(NPI)=C*POM
      NPBC(NPI)=NPBCO
      JP1=JEND+1
      XORD(NPI)=RADIUS(JP1)*C
      YORD(NPI)=RADIUS(JP1)*S
      THETA=THETA+DTHETA
350  CONTINUE
C
C      CALCULATION OF NP ARRAY
C
      MDP=+1

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      IEL=0
C      IP=(NDIVR*3)+1
      I4=NUMVP+1
      I5=I4+NDIVR
      I6=I4+IP
C      DO 550 I=1,NDIVTH
      I1=2*I-1
      I2=I1+ID
      I3=I2+ID
      DO 540 J=1,NDIVR
      IEL=IEL+1
      IF(MDP.LT.0) GO TO 520
      NP(IEL,1)=I1
      NP(IEL,2)=I1+1
      NP(IEL,3)=I1+2
      NP(IEL,4)=I2+1
      NP(IEL,5)=I3
      NP(IEL,6)=I2
      IF(NPPE.EQ.0) GO TO 510
      NP(IEL,7)=I4
      IF(NPPE.EQ.1) GO TO 510
      NP(IEL,7)=I4
      NP(IEL,8)=I5
      NP(IEL,9)=I5+1
510  CONTINUE
      IEL=IEL+1
      NP(IEL,1)=I1+2
      NP(IEL,2)=I2+2
      NP(IEL,3)=I3+2
      NP(IEL,4)=I3+1
      NP(IEL,5)=I3
      NP(IEL,6)=I2+1
      IF(NPPE.EQ.0) GO TO 530
      NP(IEL,7)=I4
      IF(NPPE.EQ.1) GO TO 530
      NP(IEL,7)=I5+1
      NP(IEL,8)=I6
      NP(IEL,9)=I5+2
      GO TO 530
520  CONTINUE
      NP(IEL,1)=I1
      NP(IEL,2)=I1+1
      NP(IEL,3)=I1+2
      NP(IEL,4)=I2+2
      NP(IEL,5)=I3+2
      NP(IEL,6)=I2+1
      IF(NPPE.EQ.0) GO TO 525
      NP(IEL,7)=I4
      IF(NPPE.EQ.1) GO TO 525
      NP(IEL,7)=I5
      NP(IEL,8)=I6
      NP(IEL,9)=I5+1
525  CONTINUE
      IEL=IEL+1
      NP(IEL,1)=I1
      NP(IEL,2)=I2+1
      NP(IEL,3)=I3+2
      NP(IEL,4)=I3+1

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      NP(IEL,5)=I3
      NP(IEL,6)=I2
      IF(NPPE.EQ.0) GO TO 530
      NP(IEL,7)=I4
      IF(NPPE.EQ.1) GO TO 530
      NP(IEL,7)=I4
      NP(IEL,8)=I5+1
      NP(IEL,9)=I5+2
530  CONTINUE
      I1=I3
      I2=I1+ID
      I3=I2+ID
      I4=I4+1
      I5=I5+2
      I6=I6+1
      MOP=-MOP
540  CONTINUE
      I4=I5+1
      I5=I4+NDIVR
      I6=I4+IP
      IF(NPPE.EQ.1) I4=I*NDIVR+1+NUMVP
550  CONTINUE
C
C
      IF(RPI.NE.2.0) GO TO 571
      IBGN=NUMEL-NDIVR*2+1
      IEND=NUMEL
      KEND=2*NDIVR+1
      DO 570 I=IBGN,IEND
      DO 570 J=1,6
      DO 569 K=1,KEND
      K1=K*ID+1
      IF(NP(I,J).NE.K1) GO TO 569
      NP(I,J)=NP(I,J)-ID
      GO TO 570
569  CONTINUE
570  CONTINUE
571  CONTINUE
C
C      READ SINGULAR BOUNDARY CONDITIONS
C
      WRITE(6,22)
      READ(5,1) NUMBC
      WRITE(6,1) NUMBC
C
      IF(NUMBC.EQ.0) GO TO 761
      WRITE(6,25)
      DO 760 I=1,NUMBC
      READ(5,24) I1,NPBC(I1),COSXXP(I1),XPC(I1),YBC(I1),TBC(I1)
      READ(5,27) CH(I1),CX(I1),CY(I1),TX(I1),TY(I1),TQ(I1)
      WRITE(6,28) I1,NPBC(I1),COSXXP(I1),XBC(I1),YBC(I1),TBC(I1),
      1 CH(I1),CX(I1),CY(I1),TX(I1),TY(I1),TQ(I1)
760  CONTINUE
761  CONTINUE
C
C
781  CONTINUE
C
      CALL MSHADJ
C

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C
C      OUTPUT OF DATA
C
      WRITE(6,14)
      WRITE(6,17) NUMNP,NUMTP,NUMVP,NUMPP,NELMC,NELMT
      WRITE(6,12)
      DO 820 I=1,NUMTP
      WRITE(6,13) I,XORD(I),YORD(I),NPBC(I),COSXXP(I),XBC(I),YBC(I),
1 TBC(I),TX(I),TY(I),TQ(I),CH(I),CX(I),CY(I)
820 CONTINUE
C
      WRITE(6,14)
      DO 840 I=1,NUMEL
      WRITE(6,15) I,(NP(I,J),J=1,NNPE)
840 CONTINUE
C
      IF(IPUNCH,NE,7) GO TO 855
      WRITE(7,17) NUMNP,NUMTP,NUMVP,NUMPP,NELMC,NELMT
C
      DO 845 I=1,NUMTP
      WRITE(7,13) I,XORD(I),YORD(I)
845 CONTINUE
      DO 850 I=1,NUMEL
      WRITE(7,15) I,(NP(I,J),J=1,NNPE)
850 CONTINUE
855 CONTINUE
C
      CALL MAP(XMIN,XMAX,YMIN,YMAX,0.0,1.0,0.0,1.0)
      DO 860 I=1,NUMEL
      I1=NP(I,1)
      I2=NP(I,2)
      I3=NP(I,3)
      I4=NP(I,4)
      I5=NP(I,5)
      I6=NP(I,6)
C
      CALL POINT(XORD(I1),YORD(I1))
      CALL VECTOR(XORD(I2),YORD(I2))
      CALL VECTOR(XORD(I3),YORD(I3))
      CALL VECTOR(XORD(I4),YORD(I4))
      CALL VECTOR(XORD(I5),YORD(I5))
      CALL VECTOR(XORD(I6),YORD(I6))
      CALL VECTOR(XORD(I1),YORD(I1))
C
860 CONTINUE
      CALL FRAME
C
C
      GO TO 7777
C
C
C      ERROR MESSAGES
C
7001 WRITE(6,5) NUMVP,IDA,IDC
      STOP
7002 WRITE(6,6) NUMNP,IDB
      STOP
7003 WRITE(6,4) NUMPP,IDE
      STOP
7004 WRITE(6,8) NUMEL,IDG

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```

      STOP
7005 WRITE(6,23)
      STOP
C
C
C
C
C
C
      FORMAT STATEMENTS
1  FORMAT(8I10)
2  FORMAT(40H0      RI      RO      RM      RPI  )
3  FORMAT(7E10,3)
4  FORMAT(14H0 NUMPP EQUALS, I5, 22H EXCEEDS DIMENSION IDE, I5)
5  FORMAT(14H0 NUMVP EQUALS, I5, 26H WHICH EXCEEDS EITHER IDA,,
1  I5, 8H OR IDC,, I5 )
6  FORMAT(14H0 NUMNP EQUALS, I5, 20H, WHICH EXCEEDS IDB,, I5)
7  FORMAT(20H0  NDIVTH  NDIVR  )
8  FORMAT(14H0 NUMEL EQUALS, I5, 27H, WHICH EXCEEDS EITHER IDF,,
1  I5, 8H OR IDG, I5)
9  FORMAT(100H0  NPBC      XBC      YBC      TBC      /      CH
1  CX      CY      TX      TY      TQ  )
10 FORMAT(1I10,3E10,3)
11 FORMAT(6E10,3)
12 FORMAT(127H0 NP      XORD      YORD NPBC COSXXP      XBC      Y
1BC      TBC      TX      TY      TQ      CH      CX      Y
1  CY      )
13 FORMAT(15,2E10,3,I5,F7,4,9E10,3)
14 FORMAT(40H0 ELEM      NP      )
15 FORMAT(10I7)
16 FORMAT(60H0  NUMNP      NUMTP      NUMVP      NUMPF      NELMC      N
1ELMT )
17 FORMAT(8I10)
18 FORMAT(10H0  IPUNCH      )
19 FORMAT(1I10)
20 FORMAT(10H0  NPPE  )
21 FORMAT(1I10)
22 FORMAT(10H0  NUMBC)
23 FORMAT(35H0 NPPE MUST EQUAL EITHER 0, 1, OR 3 )
24 FORMAT(21I10,F10,4,5E10,3)
25 FORMAT(123H0  NP      NPBC      COSXXP      XBC      YBC
1  TBC /      CH      CX      CY      TX      TY
1TR  )
26 FORMAT(110H0*****
1***** DATA FROM MESH )
27 FORMAT(6E10,3)
28 FORMAT(21I10,F10,4,3E10,3, 3H / ,6E10,3  )
29 FORMAT(1I10,9E10,3, 10H  INSIDE )
30 FORMAT(1I10,9E10,3, 11H  OUTSIDE )
C
7777 CONTINUE
      END

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OVERLAY(FLOW,2,0)
PROGRAM MESH2

C
C
COMMON/C1/
1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TQ($AA$),
3 COSXP($CC$),NPBC($AA$),NP($FF$,$EE$)

C
COMMON/C2/
1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE

C
COMMON/C5/
1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP

C
DIMENSION
1 NDIR(5,4),JOIN(5,4,2),XCOR(5,8),YCOR(5,8),LNP(5,4,100),
2 LPBC(5,4),XLBC(5,4),YLBC(5,4),CXLBC(5,4),CYLBC(5,4),TXLBC(5,4),
3 TYLBC(5,4),TQLBC(5,4),TLBC(5,4),CHBC(5,4),COSLBC(5,4),
4 LNR(4,100),NPN($BB$),RN(8),NUMLPS(2)

C
C
C
C
WRITE(6,26)
C
C
C
C
READ AND INITIALIZATION OF DATA
C
WRITE(6,20)
READ(5,21) NPPE
WRITE(6,21) NPPE

C
IF(NPPE.NE.0.AND.NPPE.NE.1.AND.NPPE.NE.3) GO TO 7001
C
C
C
NPPE=6
NTPE=6
NNPE=6+NPPE

C
WRITE(6,2)
READ(5,1) NUMLPS(1),NUMLPS(2)
WRITE(6,1) NUMLPS(1),NUMLPS(2)

C
C
C
IEND=NUMLPS(2)
DO 120 I=1,IEND
DO 120 J=1,4
LPBC(I,J)=1
XLBC(I,J)=0.0
YLBC(I,J)=0.0
TLBC(I,J)=0.0
COSLBC(I,J)=1.0
CHBC(I,J)=0.0
CXLBC(I,J)=0.0
CYLBC(I,J)=0.0
TXLBC(I,J)=0.0
TYLBC(I,J)=0.0
TQLBC(I,J)=0.0

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```

120 CONTINUE
C
  WRITE(6,4)
  READ(5,3) XMIN,XMAX,YMIN,YMAX
  WRITE(6,3)XMIN,XMAX,YMIN,YMAX
C
  WRITE(6,18)
  READ(5,19) IPUNCH
  WRITE(6,19)IPUNCH
C
  IEND=NUMLPS(2)
  DO 150 I=1,IEND
    WRITE(6,5) I
    WRITE(6,7)
    READ(5,6) NDIV(I,1),NDIV(I,2)
    WRITE(6,6)NDIV(I,1),NDIV(I,2)
C
    WRITE(6,8)
    READ(5,9) ((JOIN(I,J,K),K=1,2),J=1,4)
    WRITE(6,9)((JOIN(I,J,K),K=1,2),J=1,4)
C
    WRITE(6,10)
    READ(5,11) (XCOR(I,J), YCOR(I,J),J=1,8)
    WRITE(6,11)(XCOR(I,J), YCOR(I,J),J=1,8)
C
    WRITE(6,22)
    READ(5,1) NUMBC
    WRITE(6,1)NUMBC
C
    IF(NUMBC.EQ.0) GO TO 131
C
    WRITE(6,23)
    DO 130 J=1,NUMBC
      READ(5,24) J1,LFBC(J,J1),COSLBC(I,J1),XLBC(I,J1),YLBC(I,J1),
1 TLBC(I,J1)
      READ(5,27) CHBC(I,J1),CXLBC(I,J1),CYLBC(I,J1),TXLBC(I,J1),
1 TYLBC(I,J1),TQLBC(I,J1)
      WRITE(6,28) J1,LFBC(I,J1),COSLBC(I,J1),XLBC(I,J1),YLBC(I,J1),
1 TLBC(I,J1),CHBC(I,J1),CXLBC(I,J1),CYLBC(I,J1),TXLBC(I,J1),
1 TYLBC(I,J1),TQLBC(I,J1)
130 CONTINUE
C
131 CONTINUE
C
150 CONTINUE
C
  IEND=NUMLPS(2)
  DO 160 I=1,IEND
    NDIV(I,3)=NDIV(I,1)
    NDIV(I,4)=NDIV(I,2)
160 CONTINUE
C
  CALCULATE NUMBER OF NODAL POINTS
C
  NUMTP=0
  NUMVP=0
  NUMPP=0
  IEND=NUMLPS(2)
  DO 260 I=1,IEND
    I7=(2*NDIV(I,1)+1)*(2*NDIV(I,2)+1)

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```

      IF(I.GT.NUMLPS(1)) GO TO 230
      IF(NPPE.EQ.3) I8=I7-(NDIV(I,1)+1)*(NDIV(I,2)+1)
      IF(NPPE.EQ.1) I8=NDIV(I,1)*NDIV(I,2)
      IF(NPPE.EQ.0) I8=0
C
      NUMVP=NUMVP+I7
      NUMPP=NUMPP+I8
230  CONTINUE
      NUMTP=NUMTP+I7
C
      J1=4
      DO 250 J=1,4
      IF(JOIN(I,J,1).EQ.0) GO TO 249
      NUMTP=NUMTP-(2*NDIV(I,J)+1)
      IF(JOIN(I,J1,1).NE.0) NUMTP=NUMTP+1
      IF(I.GT.NUMLPS(1)) GO TO 249
      NUMVP=NUMVP-(2*NDIV(I,J)+1)
      IF(NPPE.EQ.3) NUMPP=NUMPP-(NDIV(I,J))
      IF(JOIN(I,J1,1).NE.0) NUMVP=NUMVP+1
249  CONTINUE
      J1=J
C
250  CONTINUE
260  CONTINUE
C
      NUMNP=NUMVP+NUMPP
      IF(NUMTP.GT.NUMNP) NUMNP=NUMTP
C
C
      IF(NUMTP.GT.IDA.OR.NUMVP.GT.IDA) GO TO 7002
      IF(NUMNP.GT.IDB) GO TO 7003
      IF(NUMVP.GT.IDC) GO TO 7004
      IF(NUMPP.GT.IDD) GO TO 7005
      IF(NELMT.GT.IDF) GO TO 7006
      IF(NELMC.GT.IDG) GO TO 7007
C
C
C
      IEND=NUMVP
      IF(NUMTP.GT.NUMVP) IEND=NUMTP
      DO 280 I=1,IEND
      NPBC(I)=1
      COSXXP(I)=1.0
      XBC(I)=0.0
      YBC(I)=0.0
      TBC(I)=0.0
      CH(I)=0.0
      CX(I)=0.0
      CY(I)=0.0
      TX(I)=0.0
      TY(I)=0.0
      TQ(I)=0.0
      XDRD(I)=-0.0
      YORD(I)=-0.0
280  CONTINUE
C
      ITP=0
      IVP=0
      IPP=NUMVP
      IEL=0

```

```

      IELC=0
      IFACT=0.001
C
      IEND=NUMLPS(2)
      DO 720 I=1,IEND
C
      I1=NDIV(I,1)
      I2=2*I1+1
      I3=3*I1+1
C
      I4=NDIV(I,2)
      I5=2*I4+1
      I6=3*I4+1
C
      I7=I2*I5
      IF(NPPE.EQ.3) I8=I7-(I1+1)*(I4+1)
      IF(NPPE.EQ.1) I8=I1*I4
      IF(NPPE.EQ.0) I8=0
      IF(I.GT.NUMLPS(1)) I8=0
      I9=I7+I8
C
C      CALCULATE SIDE ARRAYS
C
      JEND=I2
C
      J2=I7-I2
      J4=I2+1
C
      DO 320 J=1,JEND
      J4=J4-1
      LNR(1,J)=J
      LNR(3,J4)=J2+J
320 CONTINUE
C
      IF(NPPE.NE.3) GO TO 331
      IF(I.GT.NUMLPS(1)) GO TO 331
C
      JBGN=JEND+1
      JEND=JEND+I1
C
      J1=(I7+1)-JBGN
      J2=(I7+I8-I1+1)-JBGN
      J4=I3+1
C
      DO 330 J=JBGN,JEND
      J4=J4-1
      LNR(1,J)=J1+J
      LNR(3,J4)=J2+J
330 CONTINUE
331 CONTINUE
C
C
      JEND=I5
C
      J4=I5+1
C
      DO 340 J=1,JEND
      J4=J4-1
      LNR(2,J)=J*I2
      LNR(4,J4)=(J-1)*I2+1

```

```

340 CONTINUE
C
  IF(NPPE.NE.3) GO TO 355
  IF(I.GT.NUMLPS(1)) GO TO 355
C
C
C
  JBGJ=JEND+1
  JEND=JEND+I4
C
  J1=1
  J4=I6+1
C
  DO 350 J=JBGJ,JEND
    J4=J4-1
    LNR(2,J)=I7+J1*(I1+I2)
    LNR(4,J4)=LNR(2,J)-I2+1
    J1=J1+1
350 CONTINUE
C
355 CONTINUE
C
C
C
  CALCULATE NPN ARRAY
C
  JEND=I9
C
  DO 415 J=1,JEND
    NPN(J)=0
415 CONTINUE
C
  DO 440 J=1,4
    IF(JOIN(I,J,1).EQ.0) GO TO 440
C
    J1=JOIN(I,J,1)
    J2=JOIN(I,J,2)
C
    KEND=2*NDIV(I,J)+1
    K2=KEND+1
C
    DO 425 K=1,KEND
      K1=LNR(J,K)
      K2=K2-1
      NPN(K1)=LNP(J1,J2,K2)
425 CONTINUE
C
  IF(NPPE.NE.3) GO TO 440
  IF(I.GT.NUMLPS(1)) GO TO 440
C
C
C
  KBGJ=KEND+1
  KEND=3*NDIV(I,J)+1
  K2=KEND+1
C
  DO 435 K=KBGJ,KEND
    K1=LNR(J,K)
    K2=K2-1
    NPN(K1)=LNP(J1,J2,K2)
435 CONTINUE
C

```

```

440 CONTINUE
C
  JEND=I7
  DO 460 J=1,JEND
    IF(NPN(J).NE.0) GO TO 460
    ITP=ITP+1
    NPN(J)=ITP
    IF(I.GT.NUMLPS(1)) GO TO 460
    IVP=IVP+1
460 CONTINUE
C
C
  IF(I.GT.NUMLPS(1)) GO TO 471
  JBGJ=JEND+1
  JEND=I9
C
  DO 470 J=JBGJ,JEND
    IF(NPN(J).NE.0) GO TO 470
    IPP=IPP+1
    NPN(J)=IPP
470 CONTINUE
471 CONTINUE
C
C
C
  IF(NPPE.EQ.3) JEND=I3
  IF(NPPE.NE.3) JEND=I2
  IF(I.GT.NUMLPS(1)) JEND=I2
C
  DO 485 J=1,JEND
    J1=LNR(1,J)
    J3=LNR(3,J)
C
    LNP(I,1,J)=NPN(J1)
    LNP(I,3,J)=NPN(J3)
C
485 CONTINUE
C
  IF(NPPE.EQ.3) JEND=I6
  IF(NPPE.NE.3) JEND=I5
  IF(I.GT.NUMLPS(1)) JEND=I5
C
  DO 487 J=1,JEND
    J2=LNR(2,J)
    J4=LNR(4,J)
C
    LNP(I,2,J)=NPN(J2)
    LNP(I,4,J)=NPN(J4)
487 CONTINUE
C
C
C
  FORMULATE BOUNDARY CONDITIONS
C
  DO 495 J=1,4
    KEND=I2
    IF(J.EQ.2.OR.J.EQ.4) KEND=I5
C
  DO 495 K=1,KEND
    K1=LNP(I,J,K)

```



```

      NPBC(LNP(I,J,K))=LPBC(I,J)
      COSXXP(LNP(I,J,K))=COSLBC(I,J)
      XBC(LNP(I,J,K))=XLBC(I,J)
      YBC(LNP(I,J,K))=YLBC(I,J)
      TBC(LNP(I,J,K))=TLBC(I,J)
      CH(LNP(I,J,K))=CHBC(I,J)
      CX(LNP(I,J,K))=CXLBC(I,J)
      CY(LNP(I,J,K))=CYLBC(I,J)
      TX(LNP(I,J,K))=TXLBC(I,J)
      TY(LNP(I,J,K))=TYLBC(I,J)
      TR(LNP(I,J,K))=TRLBC(I,J)
495  CONTINUE
C
C
C
C
C   CALCULATE NODAL POINT COORDINATES
C
      R=2*I1
      DX=1.0/R
      R=2*I4
      DY=1.0/R
C
      JEND=I5
C
      KEND=I2
C
      K1=0
C
      DO 550 J=1,JEND
        R=J-1
        RY=R*DY
C
        DO 540 K=1,KEND
          R=K-1
          RX=R*DX
          RN(1)=+1.0*(1.0-RX)*(1.0-RY)*(1.0-2.0*RX-2.0*RY)
          RN(2)=+4.0*(RX)*(1.0-RX)*(1.0-RY)
          RN(3)=-1.0*(RX)*(1.0-RY)*(1.0-2.0*RX+2.0*RY)
          RN(4)=+4.0*(RX)*(RY)*(1.0-RY)
          RN(5)=-1.0*(RX)*(RY)*(3.0-2.0*RX-2.0*RY)
          RN(6)=+4.0*(RX)*(1.0-RX)*(RY)
          RN(7)=-1.0*(1.0-RX)*(RY)*(1.0+2.0*RX-2.0*RY)
          RN(8)=+4.0*(1.0-RX)*(RY)*(1.0-RY)
          K1=K1+1
          K2=NP(K1)
          XORD(K2)=0.0
          YORD(K2)=0.0
          DO 530 L=1,8
            XORD(K2)=XORD(K2)+RN(L)*XCOR(I,L)
            YORD(K2)=YORD(K2)+RN(L)*YCOR(I,L)
530  CONTINUE
C
540  CONTINUE
550  CONTINUE
C
C   CALCULATION OF NP ARRAY
C
      JEND=I4
      KEND=I1

```

```

C      DO 660 J=1,JEND
C      DO 650 K=1,KEND

      IEL=IEL+2
      IF(I.LE,NUMLPS(1)) IELC=IELC+2
      N1=IEL-1
      N2=IEL

C      K1=(J-1)*2*I2+(K-1)*2+1
      K2=K1+1
      K3=K1+2
      K4=K1+I2
      K5=K4+1
      K6=K4+2
      K7=K1+2*I2
      K8=K7+1
      K9=K7+2
      IF(NPPE, EQ, 3) K10=(J-1)*I3+I7+K
      IF(NPPE, EQ, 1) K10=(J-1)*I1+I7+K
      IF(NPPE, EQ, 0) K10=0,0
      IF(I.GT, NUMLPS(1)) K10=0
      K11=K10+I1+K-1
      K12=K11+1
      K13=K11+2
      K14=K10+I3

C      K1=NPN(K1)
      K2=NPN(K2)
      K3=NPN(K3)
      K4=NPN(K4)
      K5=NPN(K5)
      K6=NPN(K6)
      K7=NPN(K7)
      K8=NPN(K8)
      K9=NPN(K9)
      K10=NPN(K10)
      K11=NPN(K11)
      K12=NPN(K12)
      K13=NPN(K13)
      K14=NPN(K14)

C      D1=(XORD(K9)-XORD(K1))*2+(YORD(K9)-YORD(K1))*2
      D2=(XORD(K7)-XORD(K3))*2+(YORD(K7)-YORD(K3))*2

C      D1=D1+DFACT*D1
      DFACT=-1.0*DFACT

C
C      IF(D2.LT,D1) GO TO 630

C      NP(N1,1)=K1
      NP(N1,2)=K5
      NP(N1,3)=K9
      NP(N1,4)=K8
      NP(N1,5)=K7
      NP(N1,6)=K4
      NP(N1,7)=K12
      NP(N1,8)=K14
      NP(N1,9)=K11

```

```

      IF(NPPE.EQ.1) NP(N1,7)=K10
C
      NP(N2,1)=K1
      NP(N2,2)=K2
      NP(N2,3)=K3
      NP(N2,4)=K6
      NP(N2,5)=K9
      NP(N2,6)=K5
      NP(N2,7)=K10
      NP(N2,8)=K13
      NP(N2,9)=K12
C
      GO TO 650
630 CONTINUE
C
      NP(N1,1)=K1
      NP(N1,2)=K2
      NP(N1,3)=K3
      NP(N1,4)=K5
      NP(N1,5)=K7
      NP(N1,6)=K4
      NP(N1,7)=K10
      NP(N1,8)=K12
      NP(N1,9)=K11
C
      NP(N2,1)=K3
      NP(N2,2)=K6
      NP(N2,3)=K9
      NP(N2,4)=K8
      NP(N2,5)=K7
      NP(N2,6)=K5
      NP(N2,7)=K13
      NP(N2,8)=K14
      NP(N2,9)=K12
      IF(NPPE.EQ.1) NP(N2,7)=K10
C
650 CONTINUE
660 CONTINUE
C
C
720 CONTINUE
      NELMT=IEL
      NELMC=IELC
      NUMEL=NELMT
C
C      READ SINGULAR BOUNDARY CONDITIONS
C
      WRITE(6,22)
      READ(5,1) NUMBC
      WRITE(6,1)NUMBC
C
      IF(NUMBC.EQ.0) GO TO 761
      WRITE(6,25)
      DO 760 I=1,NUMBC
      READ(5,24) I1,NPBC(I1),COSXXP(I1),XBC(I1),YBC(I1),TBC(I1)
      READ(5,27) CH(I1),CX(I1),CY(I1),TX(I1),TY(I1),TR(I1)
      WRITE(6,28) I1,NPBC(I1),COSXXP(I1),XBC(I1),YBC(I1),TBC(I1),
      1 CH(I1),CX(I1),CY(I1),TX(I1),TY(I1),TR(I1)
760 CONTINUE
761 CONTINUE

```

```

C
C
      IF(NPPE.EQ.0) GO TO 781
      IF(NELMT.LE.NELMC) GO TO 781
      IBGN=NELMC+1
      JBGN=NUPE+1
      JEND=NUPE+NPPE
      DO 780 I=IBGN,NELMT
      DO 780 J=JBGN,JEND
      NP(I,J)=0
780  CONTINUE
781  CONTINUE
C
      CALL MSHADJ
C
C
      OUTPUT OF DATA
C
      WRITE(6,16)
      WRITE(6,17) NUMNP,NUMTP,NUMVP,NUMPP,NELMC,NELMT
      WRITE(6,12)
      DO 820 I=1,NUMTP
      WRITE(6,13) I,XORD(I),YORD(I),NPBC(I),COSXXP(I),XBC(I),YBC(I),
1  TRC(I),TX(I),TY(I),TR(I),CH(I),CX(I),CY(I)
820  CONTINUE
C
      WRITE(6,14)
      DO 840 I=1,NUMEL
      WRITE(6,15) I,(NP(I,J),J=1,NNPE)
840  CONTINUE
C
      IF(IPUNCH.NC.7) GO TO 855
      WRITE(7,17) NUMNP,NUMTP,NUMVP,NUMPP,NELMC,NELMT
C
      DO 845 I=1,NUMTP
      WRITE(7,13) I,XORD(I),YORD(I)
845  CONTINUE
      DO 850 I=1,NUMEL
      WRITE(7,15) I,(NP(I,J),J=1,NNPE)
850  CONTINUE
855  CONTINUE
C
      CALL MAP(XMIN,XMAX,YMIN,YMAX,0.0,1.0,0.0,1.0)
      DO 860 I=1,NUMEL
      I1=NP(I,1)
      I2=NP(I,2)
      I3=NP(I,3)
      I4=NP(I,4)
      I5=NP(I,5)
      I6=NP(I,6)
C
      CALL POINT(XORD(I1),YORD(I1))
      CALL VECTOR(XORD(I2),YORD(I2))
      CALL VECTOR(XORD(I3),YORD(I3))
      CALL VECTOR(XORD(I4),YORD(I4))
      CALL VECTOR(XORD(I5),YORD(I5))
      CALL VECTOR(XORD(I6),YORD(I6))
      CALL VECTOR(XORD(I1),YORD(I1))
860  CONTINUE
C

```

```

      CALL FRAME
C
C
C
      GO TO 7777
C
C
C
      ERROR MESSAGES
C
7001 WRITE(6,29)
      STOP
7002 WRITE(6,30) NUMTP,NUMVP,IDA
      STOP
7003 WRITE(6,31) NUMNP,IDB
      STOP
7004 WRITE(6,32) NUMVP,IDC
      STOP
7005 WRITE(6,33) NUMPP,IDD
      STOP
7006 WRITE(6,34) NELMT,IDF
      STOP
7007 WRITE(6,35) NELMC,IDG
      STOP
C
C
C
      FORMAT STATEMENTS
C
1 FORMAT(8I10)
2 FORMAT(20H0NUMLPS(1) NUMLPS(2) )
3 FORMAT(7E10,3)
4 FORMAT(40H0 XMIN XMAX YMIN YMAX )
5 FORMAT(//,12H LOOP NUMBER , IS)
6 FORMAT(2I10)
7 FORMAT(20H0NDIV(I,1) NDIV(I,2) )
8 FORMAT(20H0 JOIN(I,J,K) ARRAY )
9 FORMAT(4(I7,I3))
10 FORMAT(20H0 XCOR YCOR )
11 FORMAT(2E10,3)
12 FORMAT(127H0 NP XORD YORD NPBC COSXXP XBC CX Y
1 BC TBC TX TY TQ CH
1 CY )
13 FORMAT(15,2E10,3,15,F7,4,9E10,3)
14 FORMAT(40H0 ELEM NP )
15 FORMAT(10I7)
16 FORMAT(60H0 NUMNP NUMTP NUMVP NUMPP NELMC N
1ELMT )
17 FORMAT(8I10)
18 FORMAT(10H0 IPUNCH )
19 FORMAT(I10)
20 FORMAT(10H0 NPPE )
21 FORMAT(I10)
22 FORMAT(10H0 NUMBC)
23 FORMAT(123H0 SIDE BC COSXXP XBC YBC
1 TBC / CH CX CY TX TY
1TQ )
24 FORMAT(2I10,F10,4,5E10,3)
25 FORMAT(123H0 NP NPBC COSXXP XBC YBC
1 TBC / CH CX CY TX TY
1TQ )

```

```

26 FORMAT(110H0*****  

1***** DATA FROM MESH )  

27 FORMAT(6E10.3)  

28 FORMAT(2I10,F10.4,3E10.3, 3H / ,6E10.3 )  

29 FORMAT(35H0 NPFE MUST EQUAL EITHER 0, 1, OR 3 )  

30 FORMAT(8H0 NUMVP,,I4,10H,OR NUMTP,,I4,21H IS GREATER THAN IDA,  

1 ,I4)  

31 FORMAT(14H0 NUMNP EQUALS,I5,28H, WHICH IS GREATER THAN IDB,,I5)  

32 FORMAT(14H0 NUMVP EQUALS,I5,28H, WHICH IS GREATER THAN IDC,,I5)  

33 FORMAT(14H0 NUMPP EQUALS,I5,28H, WHICH IS GREATER THAN IDD,,I5)  

34 FORMAT(14H0 NELMT EQUALS,I5,28H, WHICH IS GREATER THAN IDF,,I5)  

35 FORMAT(14H0 NELMC EQUALS,I5,28H, WHICH IS GREATER THAN IIG,,I5)  

C  

7777 CONTINUE  

END

```

```

OVERLAY(FLOW,3,0)
PROGRAM WAVE
C
COMMON/C1/
1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TR($AA$),
3 CO3XXP($CC$),NPBC($AA$),NP($FF$,$EE$)
C
COMMON/C2/
1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
COMMON/C3/
1 IELE($II$),NPR($BB$),LIST($JJ$),MOVE($JJ$),INTD($JJ$),
2 IDIAG(2,$JJ$)
C
COMMON/C4/
1 KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
2 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPTY
C
COMMON/C5/
1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C
DIMENSION
1 IORDER(2,$FF$),LSTCP($JJ$),LSTIC($JJ$),LSTOLD($JJ$),
2 NPIX($BB$),MSHCD(2)
C
NTPE=4
NVPE=6
C
C
C
WRITE(6,20)
C
REWIND 1
REWIND 3
C
WRITE(6,19)
READ(5,4) MSHCD(1),MSHCD(2)
WRITE(6,4)MSHCD(1),MSHCD(2)
C
DO 1000 IO=1,2
C
IF(MSHCD(IO).EQ.0) GO TO 1000
C
WRITE(6,27) IO
NNPE=NVPE+NPPE
NUMNP=NUMVP+NUMPP
NUMEL=NELMC
IF(IO.EQ.1) GO TO 120
NUMNP=NUMTP
NUMEL=NELMT
NNPE=NTPE
120 CONTINUE
C
C
FORMULATE NPIX ARRAY AND INITIALIZE NPR ARRAY
C
DO 130 I=1,NUMNP
NPIX(I)=0
NPR(I)=0
130 CONTINUE

```

```

C      DO 135 I=1,NUMEL
C      DO 135 J=1,NNPE
C      J1=NF(I,J)
C      NPIX(J1)=NPIX(J1)+1
135 CONTINUE
C      IF (NUMNP.EQ.NUMVP) GO TO 138
C      IF (IO.EQ.2) GO TO 138
C      IBGN=NUMVP+1
C      DO 137 I=IBGN,NUMNP
C      NPIX(I)=NUPE*NPIX(I)
137 CONTINUE
138 CONTINUE
C      WRITE(6,15)
C      READ(5,4) MAXVOL,IBMIN
C      WRITE(6,4)MAXVOL,IBMIN
C      DO 140 I=1,NUMEL
C      IORDER(IO,I)=I
140 CONTINUE
C
C      WRITE(6,10)
C      READ(5,4) IREAD
C      WRITE(6,4)IREAD
C
C      IF (IREAD.NE.5) GO TO 150
C
C      READ(5,11) (IORDER(IO,I),I=1,NUMEL)
150 CONTINUE
C      WRITE(6,12)
C      WRITE(6,11)(IORDER(IO,I),I=1,NUMEL)
C
C
C
C      CHECK TO SEE IF ALL ELEMENTS ARE ACCOUNTED FOR
C      (TEMPORARY USE OF NPR ARRAY )
C
C      DO 160 I=1,NUMEL
C      NPR(I)=1
160 CONTINUE
C      DO 165 I=1,NUMEL
C      I1=IORDER(IO,I)
C      NPR(I1)=NPR(I1)-1
165 CONTINUE
C      DO 170 I=1,NUMEL
C      IF (NPR(I1).NE.0) GO TO 7004
170 CONTINUE
C
C
C      FORMULATE TAPE SEGMENTS
C
C      INITIALIZE

```



```

C      DO 230 I=1,IDJ
        LIST(I)=0
        LSTCP(I)=0
        LSTIC(I)=0
230  CONTINUE
C      DO 231 I=1,IDI
        IELE(I)=0
231  CONTINUE
C
C      NUMSEG(I0)=0
        IBMIO=IBMIN
        NQMIO=0
        LSTICX=0
        LSTCPX=0
        IROLD=0
        IELEX=0
        IEMPT=0
C
C
C
C
C
C      WRITE(6,9)
C
C      DO 900 I=1,NUMEL
C
C        I1=IORDER(I0,I)
        IELEX=IELEX+1
        IELE(IELEX)=I1
C
C      PLACE NEW NODAL POINTS IN LSTIN
C
C      DO 330 J=1,NNPE
        J1=NP(I1,J)
        IF(J1.GT.NUMVP.AND.I0.EQ.1) GO TO 320
        NPIX(J1)=NPIX(J1)+1
230  CONTINUE
        KEND=LSTICX
        IF(KEND.EQ.0) GO TO 326
C
C      DO 325 K=1,KEND
        IF(J1.EQ.LSTIC(K)) GO TO 330
235  CONTINUE
236  CONTINUE
        LSTICX=LSTICX+1
        LSTIC(LSTICX)=J1
230  CONTINUE
C
C
C      TRANSFER COMPLETED N.P. TO LSTCP
C
C      335 CONTINUE
        IPCHK=0
C
        JEND=LSTICX

```

```

      DO 360 J=1,JEND
340  CONTINUE
      J1=LSTIC(J)
      IF(J1.EQ.0) GO TO 360
      IF(NPIX(J1).GT.0) GO TO 360
C
      IF(I0.EQ.2) GO TO 348
      IF(NUMVP.EQ.NUMNP) GO TO 348
      IF(J1.GT.NUMVP) GO TO 348
C
      DO 345 K=1,I
      L1=IORDER(1,K)
      L1 345 L=1,NVPE
      L1=NP(K1,L)
      IF(L1.NE.J1) GO TO 345
      MBGN=NVPE+1
      DO 343 M=MBGN,NNPE
      M1=NP(K1,M)
      NPIX(M1)=NPIX(M1)-1
343  CONTINUE
345  CONTINUE
C
C
      IPCHK=1
C
348  CONTINUE
C
      LSTCPX=LSTCPX+1
      LSTCP(LSTCPX)=J1
C
      DO 350 K=J,LSTICX
      LSTIC(K)=LSTIC(K+1)
350  CONTINUE
      LSTICX=LSTICX-1
      GO TO 340
360  CONTINUE
C
      IF(IPCHK.EQ.1) GO TO 335
C
C
C
C
      CALCULATE NPR ARRAY
C
      DO 375 J=1,NUMNP
      IF(NPR(J).EQ.-1) GO TO 375
      NPR(J)=0
375  CONTINUE
C
      DO 385 J=1,LSTCPX
      J1=LSTCP(J)
      NPR(J1)=J
385  CONTINUE
C
      IF(LSTICX.EQ.0) GO TO 388
      DO 387 J=1,LSTICX
      J1=LSTIC(J)
      NPR(J1)=J+LSTCPX
387  CONTINUE
388  CONTINUE
C

```

```

C      CALCULATE CURRENT IB
C
C      IB=0
C
C      DO 430 J=1,NUMEL
C      DO 420 K=1,NNPE
C      K1=NP(J,K)
C      K2=NPR(K1)
C      IF(K2.LE.0) GO TO 420
C
C      DO 410 L=1,NNPE
C      L1=NP(J,L)
C      L2=NPR(L1)
C      IF(L2.EQ.0) GO TO 410
C      L2=IABS(L2)
C      IBCHK=IABS(K2-L2)+1
C      IF(IBCHK.GT.IB) IB=IBCHK
410  CONTINUE
420  CONTINUE
430  CONTINUE
C
C
C      IF(IB.GT.IBMIO) IBMIO=IB
C      LISTX=LSTCPX+LSTICK
C      IF(LISTX.GT.NQMIO) NQMIO=LISTX
C
C      ESTIMATE STORAGE REQUIREMENTS FOR AN ADDITIONAL ELEMENT
C
C      IF(I.EQ.NUMEL) GO TO 499
C
C      IBCHK=IB+(NNPE-3)
C      NQCHK=LISTX+(NNPE-3)
C
C      IF(IBCHK.LT.IBMIO.AND.NQCHK.LT.NQMIO) GO TO 900
C
C      IF(NQCHK.LT.NQMIO) NQCHK=NQMIO
C      IF(IBCHK.LT.IBMIO) IBCHK=IBMIO
C
C      KCHK=(NQCHK-IBCHK)*IBCHK+((IBCHK**2-IBCHK)/2)+IBCHK
C      IF(KCHK.LT.MAXVOL) GO TO 900
C
C
C      499 CONTINUE
C
C      PLACE ON TAPE AND PREPARE FOR NEW SEGMENT
C
C      CALCULATE KVOL FOR CURRENT SEGMENT
C
C      KVOL=(LISTX-IB)*IB+((IB**2-IB)/2)+IB
C      KMIO=(NQMI0-IBMIO)*IBMIO+((IBMIO**2-IBMIO)/2)+IBMIO
C
C      NUMSEG(I0)=NUMSEG(I0)+1
C
C
C      FORMULATE LIST
C
C      DO 510 J=1,LSTCPX
C      LIST(J)=LSTCP(J)

```

```

510 CONTINUE
C
    DO 515 J=1,LSTICX
        J1=LSTCPX+J
        LIST(J1)=LSTIC(J)
515 CONTINUE
C
    ICOMP=LSTCPX
C
C
C    FORMULATE MOVE AND INTO ARRAYS
C
    DO 530 J=1,IDJ
        MOVE(J)=0
        INTO(J)=0
530 CONTINUE
C
    MOVEX=0
C
C
    IF(NUMSEG(I0).LE.1) GO TO 680
C
    JEND=LSTOLX
    IF(JEND.LT.LISTX) JEND=LISTX
C
    DO 650 J=1,JEND
        J1=J
C
620 CONTINUE
    J2=LSTOLD(J1)
    J3=LIST(J1)
    IF(J2.NE.0) GO TO 640
    IF(J3.EQ.0) GO TO 650
C
    DO 630 K=1,JEND
        K1=K
        K2=LSTOLD(K1)
        IF(K2.NE.J3) GO TO 630
        MOVEX=MOVEX+1
        MOVE(MOVEX)=K1
        INTO(MOVEX)=J1
        LSTOLD(J1)=J3
        LSTOLD(K1)=0
        IF(K1.GT.J) GO TO 650
        J1=K1
        GO TO 620
630 CONTINUE
C
    IF(J1.LE.J) LSTOLD(J1)=LIST(J1)
    GO TO 650
640 CONTINUE
    IF(J2.NE.J3) GO TO 650
    MOVEX=MOVEX+1
    MOVE(MOVEX)=J1
    INTO(MOVEX)=J1
650 CONTINUE
C
C
C    HAS MOVE BEEN SUCCESSFUL
C

```

```

C      ICHK=0
      DO 670 J=1,JEND
      IF(LSTOLD(J).NE.LIST(J)) ICHK=+1
670  CONTINUE
C      IF(ICHK.NE.0) GO TO 7003
C
C
C      KMIO=(NQMIO-IBMIO)*IBMIO+((IBMIO**2-IBMIO)/2)+IBMIO
C
C
C880  CONTINUE
C
C      NSEG=NUMSEG(IO)
C
C      IF(ICOMP.LT.1) GO TO 7001
C
C      WRITE(6,8) NSEG,KVOL
      WRITE(6,2) NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPTY
      WRITE(6,2) (IELE(J),J=1,IELEX)
      WRITE(6,2) (LIST(J),J=1,LISTX)
C      WRITE(6,2) (NPR(J),J=1,NUMNP) ***** SUPRESSED *****
      WRITE(6,2) (MOVE(J),J=1,MOVEX)
      WRITE(6,2) (INTO(J),J=1,MOVEX)
      IF(IO.EQ.1) WRITE(1)
1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPTY,IELE,NPR,LIST,MOVE,INTO
      IF(IO.EQ.2) WRITE(3)
1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPTY,IELE,NPR,LIST,MOVE,INTO
      IF(LISTX.GT.IDJ) GO TO 7005
      IF(IELEX.GT.IDI) GO TO 7005
C
C
C      INITIALIZE FOR NEXT TAPE SEGMENT
C
C      IF(I.EQ.NUMEL) GO TO 900
C
C
C      DO 885 J=1,ICOMP
      J1=LIST(J)
      NPR(J1)=-1
885  CONTINUE
      DO 890 J=1,IDJ
      LSTOLD(J)=LIST(J)
      LIST(J)=0
      LSTCP(J)=0
890  CONTINUE
C
C      DO 891 J=1,IDI
      IELE(J)=0
891  CONTINUE
C
C      DO 892 J=1,ICOMP
      LSTOLD(J)=0
892  CONTINUE
C

```

```

C      IEMPT=ICOMP
C      IELEX=0
C      LSTOLX=LISTX
C      LISTX=0
C      LSTCPX=0
C      IBOLD=IBMIO
C
C
C      900 CONTINUE
C
C
C      CALCULATION OF IDIAG
C
C      IF(I0.EQ.2) GO TO 930
C      IDIAG(1,1)=1
C      DO 920 I=2,NQMIO
C      I1=NQMIO-I+2
C      IF(I1.GT.IBMIO) I1=IBMIO
C      IDIAG(1,I)=IDIAG(1,I-1)+I1
C      920 CONTINUE
C      GO TO 951
C
C      930 CONTINUE
C      IBT=2*(IBMIO-1)+1
C      IDIAG(2,1)=1
C
C      DO 950 I=2,NQMIO
C      I1=IBT
C      IF(I.LT.IBMIO) I1=I1-(IBMIO-I)
C      IF(I.GT.NQMIO-IBMIO+2) I1=I1-(IBMIO-(NQMIO-I)-2)
C      IDIAG(2,I)=IDIAG(2,I-1)+I1
C      950 CONTINUE
C      951 CONTINUE
C
C
C      WRITE(6,3)
C      WRITE(6,4) KMIO,IBMIO,NQMIO,NUMSEG(I0)
C      IF(KMIO.GT.MAXVOL) WRITE(6,16) KMIO,MAXVOL
C
C      KMAX(I0)=KMIO
C      IBMAX(I0)=IBMIO
C      NQMAX(I0)=NQMIO
C
C      1000 CONTINUE
C      REWIND 1
C      REWIND 3
C      WRITE(9)XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,CQSXXP,
C      1 NPBC,NP,XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,
C      2 NPPE,KMAX,IBMAX,NQMAX,NUMSEG,IDIAG,
C      3 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C      GO TO 7777
C
C
C      ERROR MESSAGES
C
C
C
C

```

```

7001 WRITE(6,5) NUMSEG
      WRITE(6,6) (IELE(I),I=1,IELEX)
      WRITE(6,6) (LIST(I),I=1,LISTX)
      STOP
C
C
7003 WRITE(6,1)
      WRITE(6,2)(LIST(I),I=1,LISTX)
      WRITE(6,2)(LISTOLD(I),I=1,LISTX)
      STOP
C
7004 WRITE(6,13)
      WRITE(6,14)(IORDER(I),I=1,NUMEL)
      STOP
C
7005 WRITE(6,7) IDI,IDJ
      STOP
C
C
C
C      FORMAT STATEMENTS
1  FORMAT(50H0 MOVE-INTO ROUTINE NOT VALID, LIST AND LISTOLD ARE      )
2  FORMAT(20I5)
3  FORMAT(40H0      KMAX      IBMAX      NQMAX      NUMSEG )
4  FORMAT(4I10)
5  FORMAT(45H0  ERROR -- FIRST NODAL POINT IN TAPE SEGMENT  ,I5,
1  36HIS NOT COMPLETED,  IELE AND LIST ARE      )
6  FORMAT(20I5)
7  FORMAT(67H0 IELEX OR LISTX IS GREATER THAN DIMENSION IDI OR IDJ WH
1ICH EQUAL,  ,I5, 4H AND, I5)
8  FORMAT(14H0 TAPE SEGMENT  ,I4, 17H  KVOL EQUALS  ,I6)
9  FORMAT(39H0 NSEG IN LISTX ICOMP IELEX MOVEX IEMPT ,/,
1  40H  IELE(I) LIST(I) NPR(I) MOVE(I) INTO(I)      )
10 FORMAT(10H0  IREAD )
11 FORMAT(10I5)
12 FORMAT(12H0  IORDER(I) )
13 FORMAT(34H0 ERROR IN IORDER ARRAY, IORDER IS      )
14 FORMAT(20I5)
15 FORMAT(20H0  MAXVOL      IRMIN )
16 FORMAT(19H0 NOTE, KMAX EQUALS, I6, 28H WHICH EXCEEDS THE MAXVOL OF
1, I6)
19 FORMAT(20H0 MSHCD(1)  MSHCD(2) )
20 FORMAT(110H0*****
1***** DATA FROM WAVE      )
27 FORMAT(81H0*****
1***** DATA FOR MESH,  I3)
7777 CONTINUE
      END

```

```

OVERLAY(FLOW,4,0)
PROGRAM COUPLE

C
C
C
COMMON/C1/
1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TQ($AA$),
3 COSXXP($CC$),NPBC($AA$),NP($FF$,$EE$)

C
COMMON/C2/
1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE

C
COMMON/C3/
1 IELE($II$),NPR($BB$),LIST($JJ$),MOVE($JJ$),INTQ($JJ$),
2 IDIAG(2,$JJ$)

C
COMMON/C4/
1 KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
2 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT

C
COMMON/C5/
1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDU,IDP

C
COMMON/C6/
1 SF(7,6,7),WT(2,7),NUMQPT(2),ISTRES(3)

C
COMMON/C7/
1 SKXX($LL$),SKXY($LL$),SKYX($LL$),SKYY($LL$)

C
COMMON/C8/
1 TIME,DTIME,DTMAX,DUMAX,
1 DELU,DELF,DELT,DELG,
1 ITERC,ITERI,
1 DFCONV,DUCONV,DTCONV,DQCONV,
1 VECTL,CTEMP,
1 THETA,ALPHAT,TRANS,
1 INCPR,INCPU,INCPL,INTPR,INTFU,INTPL,
1 INCLCU(2),INCLTU(2),INTLCU(2),INTLTU(2),
1 LCU,LTU,
1 MNI,ITMAXC,ITMAXT,
1 INCR,ITV,MOP,ITEMP,LAGEUL,IRZ

C
COMMON/C9/
1 UX($CC$),UY($CC$),UT($CC$),
2 PX($DD$),PY($DD$),IPQ($DD$,2),
3 FTX($CC$),FTY($CC$),FTQ($AA$),
4 SIGII($GG$),SIGXX($GG$,3),SIGYY($GG$,3),SIGXY($GG$,3),
5 SIGTH($GG$,3),MAT($FF$)

C
DIMENSION
1 RHS1($BB$),RHS2($BB$)

C
C
C
C
REWIND 9
READ(9) XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,
1 NPBC,NP,XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,
2 NPPE,KMAX,IBMAX,NQMAX,NUMSEG,IDIAG,

```



```

3 IDA, IDB, IDC, IDD, IDE, IDF, IDG, IDH, IDI, IDJ, IDK, IDL, IDM, IDN, IDO, IDP
C
  NTPE=6
  NVPE=6
C
  WRITE(6,5)
C
C   INPUT DATA AND INITIALIZATION
C
C
C   READ MATERIAL DATA
  NUMNP=NUMVP+NUMPP
  IF(NUMTP.GT.NUMNP) NUMNP=NUMTP
  NUMEL=NELMT
C
C
  WRITE(6,11)
  READ(5,12) NUMAT
  WRITE(6,12) NUMAT
  DO 150 I=1, NUMEL
    MAT(I)=1
150 CONTINUE
C
  IF(NUMAT.EQ.1) GO TO 160
  WRITE(6,27)
  READ(5,22) (MAT(I), I=1, NUMEL)
  WRITE(6,22) (MAT(I), I=1, NUMEL)
160 CONTINUE
C
C
C   READ RUN DATA
C
C
  WRITE(6,15)
  READ(5,16) INCPR, INCPU, INCPL
  WRITE(6,16) INCPR, INCPU, INCPL
C
  WRITE(6,17)
  READ(5,18) INTPR, INTPU, INTPL
  WRITE(6,18) INTPR, INTPU, INTPL
C
  WRITE(6,23)
  READ(5,24) ITV, MOP, TRANS, THETA, INTEMP, LAGEUL, IRZ
  WRITE(6,24) ITV, MOP, TRANS, THETA, INTEMP, LAGEUL, IRZ
C
  WRITE(6,25)
  READ(5,26) TIMEM, MNI, DUMAX, DTMAX
  WRITE(6,26) TIMEM, MNI, DUMAX, DTMAX
C
  WRITE(6,7)
  READ(5,4) ITMAXC, ITMAXT
  WRITE(6,4) ITMAXC, ITMAXT
C
  WRITE(6,2)
  READ(5,1) VECTL, CTEMP
  WRITE(6,1) VECTL, CTEMP
C
  WRITE(6,28)
  READ(5,29) INTLCU(1), INTLCU(2), INTLTU(1), INTLTU(2), LCU, LTU

```

```

WRITE(6,29)INTLCU(1),INTLCU(2),INTLTU(1),INTLTU(2),LCU,LTU
C
C
WRITE(6,30)
READ(5,31) DFCONV,DQCONV,DUCONV,DTCONV
WRITE(6,31)DFCONV,DQCONV,DUCONV,DTCONV
C
C
C
C
REWIND 1
REWIND 2
REWIND 3
REWIND 4
C
C
C
PROGRAM INITIALIZATION
C
CALL SHAFAC
1 (NPPE)
C
IF(NUMPP.EQ.0) GO TO 171
C
DO 170 I=1,NUMPP
PX(I)=0.0
PY(I)=0.0
170 CONTINUE
171 CONTINUE
C
DELU=0.0
DELF=0.0
DELT=0.0
DELQ=0.0
INCLTU(1)=INTLTU(1)
INCLCU(1)=INTLCU(1)
C
DO 175 I=1,NELMC
DO 175 J=1,3
SIGXX(I,J)=0.0
SIGYY(I,J)=0.0
SIGXY(I,J)=0.0
SIGTH(I,J)=0.0
175 CONTINUE
C
C
DO 180 I=1,NUMNP
UX(I)=0.0
UY(I)=0.0
UT(I)=0.0
180 CONTINUE
C
C
WRITE(6,3)
READ(5,4) NPPTS,NSEC
WRITE(6,4)NPPTS,NSEC
C
IF(NPTS.EQ.0) GO TO 183
WRITE(6,36)
DO 182 I=1,NPTS

```

```

      READ(5,35) I1,XORD(I1),YORD(I1),UX(I1),UY(I1),UT(I1)
      WRITE(6,35) I1,XORD(I1),YORD(I1),UX(I1),UY(I1),UT(I1)
182  CONTINUE
183  CONTINUE
C
      IF(NSEC.EQ.0) GO TO 186
      WRITE(6,8)
      DO 185 I=1,NSEC
      READ(5,9) JBGJ,JEND,INCR,TEMPO,UX0,UY0
      WRITE(6,9) JBGJ,JEND,INCR,TEMPO,UX0,UY0
C
      DO 185 J=JBGJ,JEND,INCR
      UT(J)=TEMPO
      UX(J)=UX0
      UY(J)=UY0
185  CONTINUE
C
186  CONTINUE
C
      CALL BNDRY
C
190  CONTINUE
C
C
      WRITE(6,6)
C
      TIME=0.0
      INCR=0
      DTIME=DTMAX
C
C
200  CONTINUE
C
C
C
C
C
C
      IF(ITV.GT.0) CALL CREEP
1  (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
2  IELE,NPR,LIST,MOVE,INTQ,IDIAG,
3  SKXX,SKXY,SKYX,SKYY,
4  UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,
5  RHS1,RHS2,MAT,
6  IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
      IF(ITV.GT.0) ITV=ITV*MOP
C
      IF(ITV.LT.0) CALL TEMP
1  (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
2  IELE,NPR,LIST,MOVE,INTQ,IDIAG,
3  SKXX,SKXY,SKYX,SKYY,
4  UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,
5  RHS1,RHS2,MAT,
6  IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
      IF(ITV.LT.0) ITV=ITV*MOP
C
      IF(ITEMP.NE.1) GO TO 350
      INTEMP=0
      WRITE(6,33)

```

```

        WRITE(6,1) (UT(I),I=1,NUMTP)
        GO TO 200
350 CONTINUE
C
        INCR=INCR+1
        LCU=0
        LTU=0
        IF(INCLCU(1).GT.INCR) GO TO 370
        LCU=1
        INCLCU(1)=INCLCU(1)+INTLCU(1)
370 CONTINUE
C
        IF(INCLTU(1).GT.INCR) GO TO 375
        LTU=1
        INCLTU(1)=INCLTU(1)+INTLTU(1)
375 CONTINUE
        IF(TRANS.EQ.1) GO TO 420
        IF(DELT.LE.DTCONU) MNI=INCR
        GO TO 450
420 CONTINUE
        TIME=TIME+DTIME
        IF(TIME.GE.TIMEM) MNI=INCR
        IF(LAGE.L.EQ.0) GO TO 450
        DO 440 I=1,NUMNP
        YORD(I)=YORD(I)+UY(I)*DTIME
        IF(IRZ.EQ.1.AND.XORD(I).EQ.0.0) GO TO 440
        XORD(I)=XORD(I)+UX(I)*DTIME
440 CONTINUE
450 CONTINUE
C
        IF(INCR.LT.MNI) GO TO 460
C
        INCPU=INCR
        INCPL=INCR
        INCPR=INCR
460 CONTINUE
C
        CALL PPP
        1 (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
        2 UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,MAT,
        3 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
        IF(INCR.GE.MNI) STOP
C
        IF(TRANS.EQ.0) GO TO 200
C
C
C        CALCULATE NEXT DTIME
C
        DTIME=DTMAX
        GO TO 200
C
C
C
C        FORMAT STATEMENTS
C
        1 FORMAT(10E10.3)
        2 FORMAT(20H0      VECTL      CTEMP  )
        3 FORMAT(20H0      NPTS      NSEC   )

```

```

4 FORMAT(8I10)
5 FORMAT(110H0***** DATA FROM COUPLE )
1*****
6 FORMAT(110H0***** OUTPUT DATA )
1*****
7 FORMAT(20H0 ITMAXC ITMAXT )
8 FORMAT(60H0 J8GN JEND INCR TEMPO UX0
1 UYO )
9 FORMAT(3I10,3E10.3)
11 FORMAT(10H0 NUMAT)
12 FORMAT(I10)
14 FORMAT(4E10.3)
15 FORMAT(30H0 INCPR INCPU INCPL )
16 FORMAT(3I10)
17 FORMAT(30H0 INTPR INTPU INTPL)
18 FORMAT(3I10)
22 FORMAT(20I4)
23 FORMAT(70H0 ITV MOP TRANS THETA INTEMP LA
1GUEL IRZ )
24 FORMAT(2I10,2F10.3,3I10)
25 FORMAT(40H0 TIMEM MNI DUMAX DTMAX )
26 FORMAT(E10.3,I10,2E10.3)
27 FORMAT(12H0 MAT ARRAY )
28 FORMAT(60H0INTLCU(1) INTLCU(2) INTLTU(1) INTLTU(2) LCU
1 LTU )
29 FORMAT(7I10)
30 FORMAT(40H0 DFCONV DQCONV DUCONV DTCONV )
31 FORMAT(7E10.3)
33 FORMAT(26H0 INITIALIZED TEMPERATURES )
35 FORMAT(15,2E10.3,3E18.10)
36 FORMAT(20H0 INITIALIZED VALUES ,/, 79H NP XORD YORD
1 UX UY UT )

```

C
C

END

```

SUBROUTINE CREEP
1  (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
2  IELE,NPR,LIST,MOVE,INTO,IDIAG,
3  SKXX,SKXY,SKYX,SKYY,
4  UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,
5  FX,FY,MAT,
6  IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)

C
C
C
C
  DIMENSION
1  XORD(IDA),YORD(IDA),XBC(IDC),YBC(IDC),TBC(IDA),
2  CX(IDC),CY(IDC),CH(IDA),TX(IDC),TY(IDC),TQ(IDA),
3  COSXXP(IDC),NPBC(IDA),NP(IDF,IDE)

C
  COMMON/C2/
1  XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE

C
  DIMENSION
1  IELE(IDI),NPR(IDS),LIST(IDJ),MOVE(IDJ),INTO(IDJ),IDIAG(2,IDJ)

C
  COMMON/C4/
1  KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
2  NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEHPT

C
  COMMON/C6/
1  SF(7,6,7),WT(2,7),NUMOPT(2),ISTRES(3)

C
  DIMENSION
1  SKXX(IDL),SKXY(IDL),SKYX(IDL),SKYY(IDL)

C
  COMMON/C8/
1  TIME,BTIME,DTMAX,DUMAX,
1  DELU,DELF,DELT,DELQ,
1  ITERC,ITERT,
1  DFCONV,DUCONV,DTCONV,DQCONV,
1  VECTL,CTEMP,
1  THETA,ALPHAT,TRANS,
1  INCPR,INCPU,INCPL,INTPR,INTPU,INTPL,
1  INLCU(2),INLTU(2),INTLCU(2),INTLTU(2),
1  LCU,LTU,
1  MNI,ITHAXC,ITHAXT,
1  INCR,ITV,MOP,INTEMP,LAGEUL,IRZ

C
  DIMENSION
1  UX(IDC),UY(IDC),UT(IDA),
2  PX(IDD),PY(IDD),IPQ(IDD,2),
3  FTX(IDC),FTY(IDC),FTQ(IDA),
4  SIGII(IDG),SIGXX(IDG,3),SIGYY(IDG,3),SIGXY(IDG,3),SIGTH(IDG,3),
5  MAT(IDF)

C
C
  DIMENSION
1  FX(IDB),FY(IDB)

C
  COMMON
1  TXX(9,9),TXY(9,9),TYX(9,9),TTY(9,9),
1  SXX(9,9),SXY(9,9),SYX(9,9),SYY(9,9),
1  SPX(6,3),SPY(6,3),

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```

1 SIGXXJ(3),SIGYYJ(3),SIGXYJ(3),SIGTHJ(3),
1 DNQDX(3),DNQDY(3),
1 RJAC(2,2),RJACI(2,2),DNDX(6),DNDY(6)
C
C
      NVPE=6
      NTPE=6
      NUMNP=NUMVP+NUMPP
      NNPE=NVPE+NPPE
      INCLCU(2)=INTLCU(2)
      ITERC=0
C
C
      LSTP1=NQMAX(1)+1
      IDIAG(1,LSTP1)=KMAX(1)+1
100 CONTINUE
C
      IF(LCU.EQ.1) SKBC=1.0E+20
C
C
      DO 140 I=1,NUMVP
      FX(I)=0.0
      FY(I)=0.0
      FTX(I)=0.0
      FTY(I)=0.0
140 CONTINUE
C
      IF(NUMPP.EQ.0) GO TO 146
C
      DO 145 I=1,NUMPP
      I1=NUMVP+I
      FX(I1)=0.0
      FY(I1)=0.0
      IPQ(I,1)=0
      IPQ(I,2)=0
      FTX(I1)=0.0
      FTY(I1)=0.0
145 CONTINUE
C
146 CONTINUE
C
C
C
C
      IF(LCU.EQ.0) GO TO 161
      IEND=KMAX(1)
      DO 160 I=1,IEND
      SKXX(I)=0.0
      SKXY(I)=0.0
      SKYX(I)=0.0
      SKYY(I)=0.0
160 CONTINUE
161 CONTINUE
C
C
      REWIND 1
      REWIND 2
C
C

```

```

C      FORMATION AND DIAGONALIZATION OF K MATRIX
C
C
C      IEND=NUMSEG(1)
      DO 499 I=1,IEND
C
C      READ(1)
      1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NPR,LIST,MOVE,INTO
      IF(LCU.EQ.0) READ(2) SKXX,SKXY,SKYX,SKYY,SKBC
C
      IF(I.NE.NSEG) GO TO 7007
C
      IF(I.GT.1.AND.LCU.EQ.1) CALL SLIDE
      1 (IELE,NPR,LIST,MOVE,INTO,IDIAG,SKXX,SKXY,SKYX,SKYY,
      2 IDA,IDB,IDC,IDQ,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
C
C      DO 370 J=1,IELEX
C
      IELEJ=IELE(J)
      MJ=MAT(IELEJ)
C
C
      DO 210 K=1,NNPE
      DO 210 L=1,NNPE
      SXX(K,L)=0.0
      SXY(K,L)=0.0
      SYX(K,L)=0.0
      SYY(K,L)=0.0
C
      TXX(K,L)=0.0
      TXY(K,L)=0.0
      TYX(K,L)=0.0
      TYY(K,L)=0.0
      210 CONTINUE
      DO 212 K=1,6
      DO 212 L=1,3
      SPX(K,L)=0.0
      SPY(K,L)=0.0
      212 CONTINUE
C
      VOL=0.0
C
C      BEGIN QUADRATURE
C
      KEND=NUMQPT(1)
      DO 260 K=1,KEND
C
      KPEN=K
      DO 215 L=1,3
      215 IF(ISTRES(L).EQ.K) KPEN=K
C
C
      XK=0.0
      YK=0.0
      TEMPK=0.0
      UXK=0.0

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```

      UYK=0.0
      RJAC(1,1)=0.0
      RJAC(1,2)=0.0
      RJAC(2,1)=0.0
      RJAC(2,2)=0.0
C
      DO 220 L=1,6
C
      L1=NP(IELEJ,L)
      XK=XK+SF(1,L,K)*XORD(NP(IELEJ,L))
      YK=YK+SF(1,L,K)*YORD(NP(IELEJ,L))
      TEMPK=TEMPK+SF(1,L,K)*UT(L1)
      UXK=UXK+SF(1,L,K)*UX(NP(IELEJ,L))
      UYK=UYK+SF(1,L,K)*UY(NP(IELEJ,L))
C
      RJAC(1,1)=RJAC(1,1)+SF(2,L,K)*XORD(NP(IELEJ,L))
      RJAC(1,2)=RJAC(1,2)+SF(3,L,K)*XORD(NP(IELEJ,L))
      RJAC(2,1)=RJAC(2,1)+SF(2,L,K)*YORD(NP(IELEJ,L))
      RJAC(2,2)=RJAC(2,2)+SF(3,L,K)*YORD(NP(IELEJ,L))
C
220  CONTINUE
C
      DETJ=RJAC(1,1)*RJAC(2,2)-RJAC(2,1)*RJAC(1,2)
C
      IF(DETJ.LT.0) GO TO 7002
C
      RJACI(1,1)=+RJAC(2,2)/DE TJ
      RJACI(1,2)=-RJAC(1,2)/DE TJ
      RJACI(2,1)=-RJAC(2,1)/DE TJ
      RJACI(2,2)=+RJAC(1,1)/DE TJ
C
C
      DV=DE TJ
      IF(IRZ.EQ.1) DV=XK*DE TJ
C
C
C
C
      DO 235 L=1,6
      DNDX(L)=RJACI(1,1)*SF(2,L,K)+RJACI(2,1)*SF(3,L,K)
      DNDY(L)=RJACI(1,2)*SF(2,L,K)+RJACI(2,2)*SF(3,L,K)
235  CONTINUE
C
      DO 236 L=1,3
      L1=L
      L2=L+3
      DNQDX(L)=RJACI(1,1)*SF(7,L1,1)+RJACI(2,1)*SF(7,L2,1)
      DNQDY(L)=RJACI(1,2)*SF(7,L1,1)+RJACI(2,2)*SF(7,L2,1)
236  CONTINUE
C
C
C
C
      CALCULATION OF PLASTIC STRAINS, STRESSES AND ELASTIC FORCES
C
C
C
C
C
C
      CALCULATE TOTAL STRAIN RATE AND VORTICITY
C

```

```

      EPSXX=0.0
      EPSYY=0.0
      EPSTH=0.0
      EPSXY=0.0
      OMGYX=0.0
C
      DO 240 L=1,NVPE
      LI=NP(IELEJ,L)
      EPSXX=EPSXX+DNDX(L)*UX(L1)
      EPSYY=EPSYY+DNDY(L)*UY(L1)
      EPSXY=EPSXY+(DNDX(L)*UY(L1)+DNDY(L)*UX(L1))/2.0
      OMGYX=OMGYX+(DNDY(L)*UX(L1)-DNDX(L)*UY(L1))/2.0
240  CONTINUE
      IF(IRZ.EQ.1.AND.XK.EQ.0.0) EPSTH=EPSXX
      IF(IRZ.EQ.1.AND.XK.NE.0.0) EPSTH=UXK/XK
      OMGXY=-OMGYX
C
      GK=G(TEMPK,MI)
      IF(GK.LT.0.0) GO TO 242
C
      CALCULATE STRESS RATES
C
      DXXDT=0.0
      DYYDT=0.0
      DXYDT=0.0
      DTHDT=0.0
C
      DO 241 L=1,3
      DXXDT=DXXDT+DNQDX(L)*SIGXX(IELEJ,L)*UXK
      1      +DNQDY(L)*SIGXX(IELEJ,L)*UYK
      1      -2.0*SIGXY(IELEJ,L)*OMGYX
      DYYDT=DYYDT+DNQDX(L)*SIGYY(IELEJ,L)*UXK
      1      +DNQDY(L)*SIGYY(IELEJ,L)*UYK
      1      -2.0*SIGXY(IELEJ,L)*OMGYX
      DXYDT=DXYDT+DNQDX(L)*SIGXY(IELEJ,L)*UXK
      1      +DNQDY(L)*SIGXY(IELEJ,L)*UYK
      1      -SIGXX(IELEJ,L)*OMGYX-SIGYY(IELEJ,L)*OMGYX
      IF(IRZ.EQ.0) GO TO 241
      DTHDT=DTHDT+DNQDX(L)*SIGTH(IELEJ,L)*UXK
      1      +DNQDY(L)*SIGTH(IELEJ,L)*UYK
241  CONTINUE
C
      CALCULATE PLASTIC STRAIN RATES
C
      EPSXX=EPSXX-DXXDT/(2.0*GK)
      EPSYY=EPSYY-DYYDT/(2.0*GK)
      EPSXY=EPSXY-DXYDT/(2.0*GK)
      EPSTH=EPSTH-DTHDT/(2.0*GK)
C
242  CONTINUE
C
      CALCULATE EPSII
C
      EPSII=(2.0/3.0)*(EPSXX**2+EPSYY**2+EPSTH**2+2.0*EPSXY**2)
      EPSII=SQRT(EPSII)
C
      CALL VISC(VS,VT,FENLTY,NPPE,EPSII,TEMPK,XK,YK,MJ)
C

```

```

C      IF(K.EQ.1) SIGII(IELEJ)=3.0*VS*EPSII
C
C      CALCULATE STRESS DEVIATOR
C
C      DO 243 L=1,3
C      IF(ISTRES(L).NE.K) GO TO 243
C      SIGXXJ(L)=2.0*VS*EPSXX
C      SIGYYJ(L)=2.0*VS*EPSYY
C      SIGXYJ(L)=2.0*VS*EPSXY
C      IF(IRZ.EQ.0) GO TO 243
C      SIGTHJ(L)=2.0*VS*EPSTH
243  CONTINUE
C
C      IF(DV.EQ.0.0) GO TO 260
C
C      CALCULATE BODY FORCES AND ELASTIC FORCES
C
C      GAMXK=GAMX(TEMPK,XK,YK,MJ)
C      GAMYK=GAMY(TEMPK,XK,YK,MJ)
C      IF(GK.GT.0.0) RELAX=VS/GK
C
C      WTDV=WT(1,K)*DV
C      DO 248 L=1,NVPE
C
C      L1=NP(IELEJ,L)
C
C      FXL1=SF(1,L,K)*GAMXK*WTDV
C      FYL1=SF(1,L,K)*GAMYK*WTDV
C
C      IF(GK.LT.0.0) GO TO 246
C      FXL1=FXL1+RELAX*(DNDX(L)*DXXDT+DNDY(L)*DXYDT)*WTDV
C      FYL1=FYL1+RELAX*(DNDY(L)*DYYDT+DNDX(L)*DXYDT)*WTDV
C      IF(IRZ.EQ.0) GO TO 246
C      FXL1=FXL1+RELAX*SF(1,L,K)*DTHDT*(1.0/XK)*WTDV
246  CONTINUE
C
C      IF(COSXXP(L1).EQ.1.0) GO TO 247
C      C=COSXXP(L1)
C      S=SQRT(1.0-C**2)
C      FXP=+C*FXL1+S*FYL1
C      FYP=-S*FXL1+C*FYL1
C      FXL1=FXP
C      FYL1=FYP
247  CONTINUE
C      FX(L1)=FX(L1)+FXL1
C      FY(L1)=FY(L1)+FYL1
C      FTX(L1)=FTX(L1)-FXL1
C      FTY(L1)=FTY(L1)-FYL1
248  CONTINUE
C
C
C
C
C      IST=1
C      V=VS
C      V2=2.0*VS

```

```

      IF(K.EQ.KPEN) V2=2.0*VS+PENLTY
      P=PENLTY
C
250 CONTINUE
C
      DO 257 L=1,NUPE
      DO 255 M=1,NUPE
C
      XX=(DNDX(L)*V2*DNDX(M)+DNDY(L)*V*DNDY(M))*WTDV
      YY=(DNDY(L)*V2*DNDY(M)+DNDX(L)*V*DNDX(M))*WTDV
      XY=(DNDY(L)*V*DNDX(M))*WTDV
C
      IF(IRZ.EQ.1)
1 XX=XX+SF(1,L,K)*(V2/(XK**2))*SF(1,M,K)*WTDV
C
      IF(IST.EQ.2) GO TO 252
      SXX(L,M)=SXX(L,M)+XX
      SYY(L,M)=SYY(L,M)+YY
      SXY(L,M)=SXY(L,M)+XY
      IF(LCU.EQ.0.OR.VT.NE.VS) GO TO 253
252 CONTINUE
      TXX(L,M)=TXX(L,M)+XX
      TYY(L,M)=TYY(L,M)+YY
      TXY(L,M)=TXY(L,M)+XY
253 CONTINUE
C
      IF(IST.EQ.2) GO TO 257
      IF(NPPE.NE.0.OR.K.NE.KPEN) GO TO 255
      XY=DNDX(L)*P*DNDY(M)*WTDV
      IF(IRZ.EQ.0) GO TO 254
C
      XX=(DNDX(L)*(P/XK)*SF(1,M,K)+SF(1,L,K)*(P/XK)*DNDX(M))*WTDV
      XY=XY+SF(1,L,K)*(P/XK)*DNDY(M)*WTDV
      SXX(L,M)=SXX(L,M)+XX
254 CONTINUE
      SXY(L,M)=SXY(L,M)+XY
      IF(LCU.EQ.0) GO TO 255
      TXY(L,M)=TXY(L,M)+XY
      IF(IRZ.EQ.0) GO TO 255
      TXX(L,M)=TXX(L,M)+XX
C
255 CONTINUE
C
      IF(NPPE.EQ.0) GO TO 257
      DO 256 M=1,NPPE
      SPX(L,M)=SPX(L,M)+SF(4,M,K)*DNDX(L)*WTDV
      SPY(L,M)=SPY(L,M)+SF(4,M,K)*DNDY(L)*WTDV
      IF(IRZ.EQ.1)
1 SPX(L,M)=SPX(L,M)+(SF(4,M,K)*SF(1,L,K)/XK)*WTDV
256 CONTINUE
C
257 CONTINUE
C
      IF(IST.EQ.2) GO TO 258
      IF(VT.EQ.VS) GO TO 258
      IST=2
      V=VT
      V2=2.0*VT
      IF(K.EQ.KPEN) V2=2.0*VT+PENLTY
      GO TO 250

```

```

C
C 258 CONTINUE
C
C
C
C      VOL=VOL+WTDV
C
C
C 260 CONTINUE
C
C      DO 265 K=1,3
C        SIGXX(IELEJ,K)=SIGXXJ(K)
C        SIGYY(IELEJ,K)=SIGYYJ(K)
C        SIGXY(IELEJ,K)=SIGXYJ(K)
C        IF(IRZ.EQ.1)
C          1SIGTH(IELEJ,K)=SIGTHJ(K)
C 265 CONTINUE
C
C
C
C      END OF VOLUME QUADRATURE
C
C      BEGIN SURFACE QUADRATURE
C
C      DO 290 K=1,3
C        K1=2*K
C        MIDSID=NP(IELEJ,K1)
C        SUM=TX(MIDSID)+TY(MIDSID)+CX(MIDSID)+CY(MIDSID)
C        IF(SUM.EQ.0.0) GO TO 290
C        NBC=IABS(NPBC(MIDSID))
C
C 267 IF(NBC.LT.10) GO TO 268
C        NBC=NBC-10
C        GO TO 267
C 268 CONTINUE
C
C
C
C      LEND=NUMQPT(2)
C      DO 280 L=1,LEND
C
C        XL=0.0
C        DXDXI=0.0
C        DYDXI=0.0
C
C        TXL=0.0
C        TYL=0.0
C        VXL=0.0
C        VYL=0.0
C
C        CXXL=0.0
C        CXYL=0.0
C        CYYL=0.0
C
C
C
C        M1=K1-2
C        DO 270 M=1,3
C          M1=M1+1
C          IF(M1.EQ.7) M1=1

```

```

      NPM=NP(IELEJ,M1)
C
      SF6ML=SF(6,M,L)
      SF5ML=SF(5,M,L)
C
      DXDXI=DXDXI+SF6ML*XORD(NPM)
      DYDXI=DYDXI+SF6ML*YORD(NPM)
C
      XL=XL+SF5ML*XORD(NPM)
C
      C=COSXXP(NPM)
      S=SQRT(1.0-C**2)
C
      TXL=TXL+SF5ML*(C*TX(NPM)-S*TY(NPM))
      TYL=TYL+SF5ML*(S*TX(NPM)+C*TY(NPM))
      VXL=VXL+SF5ML*(C*CX(NPM)*XBC(NPM)-S*CY(NPM)*YBC(NPM))
      VYL=VYL+SF5ML*(S*CX(NPM)*XBC(NPM)+C*CY(NPM)*YBC(NPM))
      CXXL=CXXL+SF5ML*(C*CX(NPM)*C+S*CY(NPM)*S)
      CXYL=CXYL+SF5ML*(C*CX(NPM)*S-S*CY(NPM)*C)
      CYYL=CYYL+SF5ML*(C*CX(NPM)*S+C*CY(NPM)*C)
C
270  CONTINUE
      TXL=TXL+VXL
      TYL=TYL+VYL
C
C
      DS=SQRT(DXDXI**2+DYDXI**2)
      IF(IRZ,EQ,1) DS=XL*DS
C
      M1=M1-2
      DO 280 M=1,3
      M1=M1+1
      IF(M1,EQ,7) M1=1
      NPM1=NP(IELEJ,M1)
C
      WTSFM=WT(2,L)*SF(5,M,L)
C
      C=COSXXP(NPM1)
      S=SQRT(1.0-C**2)
      FX(NPM1)=FX(NPM1)+WTSFM*(+C*TXL+S*TYL)*DS
      FY(NPM1)=FY(NPM1)+WTSFM*(-S*TXL+C*TYL)*DS
C
      TXM1=CXXL*UX(NPM1)+CXYL*UY(NPM1)
      TYM1=CXYL*UX(NPM1)+CYYL*UY(NPM1)
      FTX(NPM1)=FTX(NPM1)-WTSFM*(+C*TXM1+S*TYM1)*DS
      FTY(NPM1)=FTY(NPM1)-WTSFM*(-S*TXM1+C*TYM1)*DS
C
C
      N1=N1-2
      DO 280 N=1,3
C
      N1=N1+1
      IF(N1,EQ,7) N1=1
C
      SFNDS=SF(5,N,L)*DS
C
      SXX(M1,N1)=SXX(M1,N1)+WTSFM*CXXL*SFNDS
      SXY(M1,N1)=SXY(M1,N1)+WTSFM*CXYL*SFNDS
      SYX(M1,N1)=SYX(M1,N1)+WTSFM*CXYL*SFNDS
      SYY(M1,N1)=SYY(M1,N1)+WTSFM*CYYL*SFNDS
      IF(LCU,EQ,0) GO TO 280

```

```

      TXX(M1,N1)=TXX(M1,N1)+WTSFM*CXXL*SFNDS
      TXY(M1,N1)=TXY(M1,N1)+WTSFM*CXYL*SFNDS
      TYY(M1,N1)=TYY(M1,N1)+WTSFM*CYYL*SFNDS
C
280 CONTINUE
290 CONTINUE
C
C      END OF SURFACE QUADRATURE
C
C      END OF QUADRATURE
C
C
C
C      IF(VOL.LT.0.0) GO TO 7001
C
C
C
C      DO 316 K=1,6
C      DO 316 L=1,6
C      SYX(L,K)=SXY(K,L)
C      TYX(L,K)=TXY(K,L)
316 CONTINUE
C
C      IF(NPPE.EQ.0) GO TO 340
C
C
C      DO 330 K=1,NPPE
C      IP=NP(IELEJ,K+6)
C      IP=IP-NUHVP
C
C      IF(IPQ(IP,1).EQ.0) GO TO 324
C      IFQ(IP,2)=IELEJ
C
C      DO 322 L=1,6
C      SXX(K+6,L)=0.0
C      SXY(K+6,L)=0.0
C      SYX(K+6,L)=SPX(L,K)
C      SYY(K+6,L)=SPY(L,K)
322 CONTINUE
C
C      SXX(K+6,K+6)=0.0
C      SYY(K+6,K+6)=-1.0
C
C      GO TO 328
C
324 CONTINUE
C
C      IFQ(IP,1)=IELEJ
C
C      DO 326 L=1,6
C      SXX(K+6,L)=SPX(L,K)
C      SXY(K+6,L)=SPY(L,K)
C      SYY(K+6,L)=0.0
C      SYX(K+6,L)=0.0
326 CONTINUE
C
C
C      SXX(K+6,K+6)=0.0

```

```

      SYY(K+6,K+6)=1.0
328 CONTINUE
C
C
      DO 329 L=1,6
      SYY(L,K+6)=SYY(K+6,L)
      SYX(L,K+6)=SXY(K+6,L)
      SXX(L,K+6)=SXX(K+6,L)
      SXY(L,K+6)=SYX(K+6,L)
329 CONTINUE
330 CONTINUE
C
      DO 335 K=1,NNPE
      DO 335 L=1,NNPE
      IF(K,LT,7,AND,L,LT,7) GO TO 335
      TXK(K,L)=SXX(K,L)
      TXY(K,L)=SXY(K,L)
      TYX(K,L)=SYX(K,L)
      TYY(K,L)=SYY(K,L)
335 CONTINUE
340 CONTINUE
C
C
C      ROTATION OF BOUNDARY POINTS
C
      DO 348 K=1,NNPE
      C=CDSXXP(NP(IELEJ,K))
      IF(C,EQ,1.0) GO TO 348
      S=SQRT(1.0-C**2)
C
C
      DO 346 L=1,NNPE
C
      XX=+C*SXX(K,L)+S*SYX(K,L)
      XY=+C*SXY(K,L)+S*SYY(K,L)
      YX=-S*SXX(K,L)+C*SYX(K,L)
      YY=-S*SXY(K,L)+C*SYY(K,L)
C
      SXX(K,L)=XX
      SXY(K,L)=XY
      SYX(K,L)=YX
      SYY(K,L)=YY
C
      XX=+SXX(L,K)*C+SXY(L,K)*S
      XY=-SXX(L,K)*S+SXY(L,K)*C
      YX=+SYX(L,K)*C+SYY(L,K)*S
      YY=-SYX(L,K)*S+SYY(L,K)*C
C
      SXX(L,K)=XX
      SXY(L,K)=XY
      SYX(L,K)=YX
      SYY(L,K)=YY
C
      IF(LCU,EQ,0) GO TO 346
C
      XX=+C*TXK(K,L)+S*TYX(K,L)
      XY=+C*TXY(K,L)+S*TTY(K,L)
      YX=-S*TXK(K,L)+C*TYX(K,L)
      YY=-S*TXY(K,L)+C*TTY(K,L)
C

```



```

      TXX(K,L)=XX
      TXY(K,L)=XY
      TYX(K,L)=YX
      TYY(K,L)=YY
C
      XX=+TXX(L,K)*C+TXY(L,K)*S
      XY=-TXX(L,K)*S+TXY(L,K)*C
      YX=+TYX(L,K)*C+TYY(L,K)*S
      YY=-TYX(L,K)*S+TYY(L,K)*C
C
      TXX(L,K)=XX
      TXY(L,K)=XY
      TYX(L,K)=YX
      TYY(L,K)=YY
C
346 CONTINUE
C
348 CONTINUE
349 CONTINUE
C
C
      CALL STIFF(IELEJ,ITV)
C
C
C
      SUBTRACT SK*U FROM RHS
C
      DO 350 K=1,NNPE
      NPK=NP(IELEJ,K)
      IF(K.GT.NVPE) GO TO 354
      UXK=UX(NPK)
      UYK=UY(NPK)
      C=COSXXP(NPK)
      IF(C.EQ.1.0) GO TO 350
      S=SQRT(1.0-C**2)
      UXK=+C*UX(NPK)+S*UY(NPK)
      UYK=-S*UX(NPK)+C*UY(NPK)
350 CONTINUE
C
      NBC=IABS(NPBC(NPK))
C
351 IF(NBC.LT.10) GO TO 352
      NBC=NBC-10
      GO TO 351
352 CONTINUE
C
      IF(NBC.EQ.4.OR.NBC.EQ.2) UXK=XBC(NPK)
      IF(NBC.EQ.4.OR.NBC.EQ.3) UYK=YBC(NPK)
      GO TO 356
354 CONTINUE
      NPK=NPK-NUHVP
      UXK=PX(NPK)
      UYK=PY(NPK)
356 CONTINUE
C
      DO 358 L=1,NNPE
      IF(K.GT.NVPE.AND.L.GT.NVPE) GO TO 359
      NPL=NP(IELEJ,L)
      FXNPL=SXX(L,K)*UXK+SXY(L,K)*UYK
      FYNPL=SYX(L,K)*UXK+SYL(L,K)*UYK
      FX(NPL)=FX(NPL)-FXNPL

```

```

      FY(NPL)=FY(NPL)-FYNPL
      FTX(NPL)=FTX(NPL)+FXNPL
      FTY(NPL)=FTY(NPL)+FYNPL
358  CONTINUE
359  CONTINUE
C
C
C
      IF(LCU.EQ.0) GO TO 370
C
      PLACE IN LARGE SK MATRIX
C
C
C
      DO 366 L=1,NNPE
      L1=NPR(NP(IELEJ,L))
C
      DO 364 M=1,NNPE
      M1=NPR(NP(IELEJ,M))
      IF(M1.LT.L1) GO TO 364
      M2=IDIAG(1,L1)+(M1-L1)
      IF(M2.GE.IDIAG(1,L1+1)) GO TO 7009
C
      SKXX(M2)=SKXX(M2)+TXX(L,M)
      SKXY(M2)=SKXY(M2)+TXY(L,M)
      SKYX(M2)=SKYX(M2)+TYX(L,M)
      SKYY(M2)=SKYY(M2)+TYY(L,M)
364  CONTINUE
366  CONTINUE
C
C
C
370  CONTINUE
C
      ALL ELEMENTS ACCOUNTED FOR IN CURRENT TAPE SEGMENT
C
C
C
C
C
C
      FORMULATION OF BOUNDARY CONDITIONS
C
C
C
      DO 395 J=1,ICOMP
      J1=LIST(J)
      IF(J1.GT.NUMVP) GO TO 395
      J2=IDIAG(1,J)
C
      IF(CX(J1).EQ.0.0) FX(J1)=FX(J1)+XBC(J1)
      IF(CY(J1).EQ.0.0) FY(J1)=FY(J1)+YBC(J1)
      NBC=IABS(NPBC(J1))
C
380  IF(NBC.LT.10) GO TO 381
      NBC=NBC-10
      GO TO 380
381  CONTINUE
C

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```

      IF(NBC.EQ.1) GO TO 395
      IF(SKBC.GT.1.0) SKBC=1.0/(SKXX(J2)*SKBC)
      IF(NBC.EQ.3) GO TO 393
      IF(LCU.EQ.0) GO TO 392
      SKXX(J2)=1.0/SKBC
392  FX(J1)=0.0
      IF(NBC.EQ.2) GO TO 395
393  CONTINUE
      IF(LCU.EQ.0) GO TO 394
      SKYY(J2)=1.0/SKBC
394  FY(J1)=0.0
C
395  CONTINUE
C
C    TRIANGULARIZATION
C
C    DO 450 J=1,ICOMP
C
      J2=LIST(J)
      J1=IDIAG(1,J)
      IF(LCU.EQ.0) GO TO 420
      XX=SKXX(J1)
      XY=SKXY(J1)
      YY=SKYY(J1)
C
      SKA=XX*YY-XY*XY
C
      IF(SKA.EQ.0.0) GO TO 7004
C
      SKAI=1.0/SKA
      SRXX=+YY*SKAI
      SRXY=-XY*SKAI
      SRYX=+SRXY
      SRYI=+XX*SKAI
C
      SKXX(J1)=SRXX
      SKXY(J1)=SRXY
      SKYX(J1)=SRYX
      SKYY(J1)=SRYI
C
420  CONTINUE
C
      IF(J.EQ.LISTX) GO TO 442
      KEND=LISTX-J
      IF(KEND.GT.(IB-1)) KEND=IB-1
      DO 440 K=1,KEND
      JPK=J+K
      K1=IDIAG(1,J)+K
      K2=LIST(JPK)
C
      IF(LCU.EQ.0) GO TO 435
C
      SFXX=SKXX(K1)*SRXX+SKYX(K1)*SRYX
      SFXY=SKXX(K1)*SRXY+SKYX(K1)*SRYI
      SFYX=SKXY(K1)*SRXX+SKYY(K1)*SRYX
      SFYI=SKXY(K1)*SRXY+SKYY(K1)*SRYI
C
      L1=IDIAG(1,J)+K-1
      L2=IDIAG(1,JPK)-1

```

```

C      DO 430 L=K,KEND
C
C      L1=L1+1
C      L2=L2+1
C
C      SKXX(L2)=SKXX(L2)-SFXX*SKXX(L1)-SFXY*SKYX(L1)
C      SKXY(L2)=SKXY(L2)-SFXX*SKXY(L1)-SFXY*SKYY(L1)
C      SKYX(L2)=SKYX(L2)-SFYX*SKXX(L1)-SFYY*SKYX(L1)
C      SKYY(L2)=SKYY(L2)-SFYX*SKXY(L1)-SFYY*SKYY(L1)
430  CONTINUE
C
C
C      SKXX(K1)=SFXX
C      SKXY(K1)=SFXY
C      SKYX(K1)=SFXY
C      SKYY(K1)=SFYY
C
C
C
C      435  CONTINUE
C
C      FX(K2)=FX(K2)-SKXX(K1)*FX(J2)-SKYX(K1)*FY(J2)
C      FY(K2)=FY(K2)-SKXY(K1)*FX(J2)-SKYY(K1)*FY(J2)
C
C      440  CONTINUE
C      442  CONTINUE
C
C
C      450  CONTINUE
C      IF(LCU.EQ.0) GO TO 499
C
C      WRITE(2) SKXX,SKXY,SKYX,SKYY,SKBC
C
C      499  CONTINUE
C
C
C
C
C      DETERMINE DELF
C
C      DELF=-1.0
C      DO 610 I=1,NUMNP
C      IF(ABS(NPBC(I)).NE.1) GO TO 610
C      IF(ABS(FX(I)).GT.DELF) DELF=ABS(FX(I))
C      IF(ABS(FY(I)).GT.DELF) DELF=ABS(FY(I))
610  CONTINUE
C
C      BACK SUBSTITUTION
C
C
C
C
C      IEND=NUMSEG(1)
C      DO 480 I=1,IEND
C
C      BACKSPACE 2
C      BACKSPACE 1
C      READ(1)
C      1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NFR,LIST,MOVE,INTO
C      READ(2) SKXX,SKXY,SKYX,SKYY,SKBC

```

```

C      DO 670 J=1,ICOMP
C      J1=ICOMP+1-J
C      J2=LIST(J1)
C      J3=IDIAG(1,J1)
C      FXJ2 =SKXX(J3)*FX(J2)+SKXY(J3)*FY(J2)
C      FYJ2 =SKYX(J3)*FX(J2)+SKYY(J3)*FY(J2)
C      FX(J2)=FXJ2
C      FY(J2)=FYJ2
C      IF(J1.EQ.LISTX) GO TO 670
C
C      KRGN=IDIAG(1,J1)+1
C      J3=LISTX-J1-1
C      IF(J3.GT.IB-2) J3=IB-2
C      KEND=KRGN+J3
C
C      K1=J1
C      DO 650 K=KRGN,KEND
C      K1=K1+1
C      K2=LIST(K1)
C      FXJ2=FX(J2)-SKXX(K)*FX(K2)-SKXY(K)*FY(K2)
C      FYJ2=FY(J2)-SKYX(K)*FX(K2)-SKYY(K)*FY(K2)
C      FX(J2)=FXJ2
C      FY(J2)=FYJ2
650  CONTINUE
670  CONTINUE
C
C      BACKSPACE 2
C      BACKSPACE 1
C
C      680 CONTINUE
C
C      ROTATE FX AND FY VECTORS TO X-Y AXES
C
C      DELU=0.0
C      DO 715 I=1,NUMVP
C      IF(COSXXP(I).EQ.1.0) GO TO 705
C      C=COSXXP(I)
C      S=SQRT(1.0-C**2)
C      UXI=+C*UX(I)+S*UY(I)
C      UYI=-S*UX(I)+C*UY(I)
C      UX(I)=UXI
C      UY(I)=UYI
705  CONTINUE
C      NBC=IABS(NPRC(I))
C
C      712 IF(NBC.LT.10) GO TO 713
C      NBC=NBC-10
C      GO TO 712
713  CONTINUE
C
C      IF(NBC.EQ.4.OR.NBC.EQ.2) UX(I)=XBC(I)
C      IF(NBC.EQ.4.OR.NBC.EQ.3) UY(I)=YBC(I)
C      IF(ABS(FX(I)).GT.DELU) DELU=ABS(FX(I))
C      IF(ABS(FY(I)).GT.DELU) DELU=ABS(FY(I))

```

```

      UX(I)=UX(I)+FX(I)
      UY(I)=UY(I)+FY(I)
      IF(COSXXP(I),EQ,1.0) GO TO 715
      UXI=+C*UX(I)-S*UY(I)
      UYI=+S*UX(I)+C*UY(I)
      UX(I)=UXI
      UY(I)=UYI
715 CONTINUE
C
C      IF(NPPE,EQ,0) GO TO 721
      DO 720 I=1,NUMFP
      I1=NUMVP+I
      PX(I)=PX(I)+FX(I1)
      PY(I)=PY(I)+FY(I1)
720 CONTINUE
721 CONTINUE
C
C      CALL BNDRYC
C
C      LCU=0
C
C      ITERATION CHECK
C
      CALL SECOND(RTM)
      ITERC=ITERC+1
      IF(ITERC,EQ,1) WRITE(6,6)
      WRITE(6,5) INCR,ITERC,DELU,DELF,RTM
      IF(ITERC,GE,ITMAXC) GO TO 7777
      IF(INCR,EQ,0.AND,ITERC,LE,2) GO TO 730
      IF(DELF,LE,DFCONV) GO TO 7777
730 CONTINUE
C
C      IF(ITERC,LT,INCLCU(2)) GO TO 100
      INCLCU(2)=INCLCU(2)+INTLCU(2)
      LCU=1
      GO TO 100
C
C
C
C
7001 WRITE(6,1) VOL,IELEJ,I
      STOP
C
7002 WRITE(6,2)I
      STOP
C
7004 WRITE(6,14) I,J,J2,J1,XX,XY,YY
      STOP
7007 WRITE(6,4) I,NSEG
      STOP
7009 WRITE(6,3) I,J,K,L,M,IELEJ
      STOP
C
C      FORMAT STATEMENTS
C

```

```

1 FORMAT(14H VOLUME EQUALS, E10.3,11H IN ELEMENT, I4, 13H TAPE SEGME
  INT, I4)
2 FORMAT(*  NEGATIVE DETJ, TAPE SEGMENT*,I5)
3 FORMAT(40H MISTAKE IN PLACEMENT IN LARGE SK MATRIX ,6I5)
4 FORMAT(14H0 TAPE SEGMENT ,I5, 14H LISTS NSEG AS , I5)
5 /FORMAT(2I10,3E10.3)
6 FORMAT(50H0      INCR      ITCR      DELU      DELF      CP TIME  )
14 FORMAT(25H0 SINGULARITY DURNIG LDU , 4I6,3E15.5)
7777 CONTINUE
      RETURN
      END

```

```

SUBROUTINE TEMP
1  (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
2  IELE,NPR,LIST,MOVE,INTO,IDIAG,
3  SKTT,SKXY,SKYX,SKYY,
4  UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,
5  UTI,FQ,MAT,
6  IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
  DIMENSION
1  XORD(IDA),YORD(IDA),XBC(IDC),YBC(IDC),TBC(IDA),
2  CX(IDC),CY(IDC),CH(IDA),TX(IDC),TY(IDC),TQ(IDA),
3  COSXXP(IDC),NPBC(IDA),NP(IDF,IDE)
C
  COMMON/C2/
1  XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,MPPE
C
  DIMENSION
1  IELE(IDI),NPR(IDB),LIST(IDJ),MOVE(IDJ),INTO(IDJ),IDIAG(2,IDJ)
C
  COMMON/C4/
1  KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
2  NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
C
C
  COMMON/C6/
1  SF(7,6,7),WT(2,7),NUMOPT(2),ISTRES(3)
C
  DIMENSION
1  SKTT(IDL),SKXY(IDL),SKYX(IDL),SKYY(IDL)
C
  COMMON/C8/
1  TIME,DTIME,DTMAX,SUMAX,
1  DELU,DELF,DELT,ELLQ,
1  ITERC,ITERT,
1  DFCONV,DUCONV,DTCONV,DQCONV,
1  VECTL,CTEMP,
1  THETA,ALPHAT,TRANS,
1  INCPR,INCPU,INCPL,INTPR,INTPU,INTPL,
1  INCLCU(2),INCLTU(2),INTLCU(2),INTLTU(2),
1  LCU,LTU,
1  MNI,ITMAXC,ITMAXT,
1  INCR,ITV,MOP,INTMP,LAGEUL,IRZ
C
  DIMENSION
1  UX(IDC),UY(IDC),UT(IDA),
2  PX(IDD),PY(IDD),IPQ(IDD,2),
3  FTX(IDC),FTY(IDC),FTQ(IDA),
4  SIGII(IDG),SIGXX(IDG,3),SIGYY(IDG,3),SIGXY(IDG,3),SIGTH(IDG,3),
5  MAT(IDF)
C
  COMMON
1  CPH(9,9),CMH(9,9),
1  DNQDX(3),DNQDY(3),
1  RJAC(2,2),RJACI(2,2),DNDX(6),DNDY(6)
C
C
  DIMENSION
1  UTI(IDB),FQ(IDB)
C
C

```



```

C
C
      NVPE=6
      NTPE=6
C
C
      DO 110 I=1,NUMTP
      UTI(I)=UT(I)
110 CONTINUE
C
      INCLTU(2)=INTLTU(2)
      IVERT=0
C
C
C      BEGIN NEW ITERATION
C
130 CONTINUE
      DO 140 I=1,NUMTP
      FTQ(I)=0.0
      FQ(I)=0.0
140 CONTINUE
C
      CALL BNDRYT
C
C
      IF(LTU.EQ.1) SKBC=1.0E30
C
      ST=TRANS
      IF(ITEMP.EQ.1) ST=0.0
      IF(ST.EQ.0.0) BTIME=1.0
      TH=THETA
      IF(ST.EQ.0.0) TH=1.0
C
      IF(LTU.EQ.0) GO TO 161
C
      IEND=2*KMAX(2)-NOMAX(2)
      DO 160 I=1,IEND
      SKTT(I)=0.0
160 CONTINUE
161 CONTINUE
C
      REWIND 3
      REWIND 4
C
C
C
      IEND=NUMSEG(2)
C
      DO 650 I=1,IEND
C
C
      READ(3)
      1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NPR,LIST,MOVE,INTO
      IF(LTU.EQ.0) READ(4) SKTT,SKXY,SKYX,SKYY,SKBC
C
      IF(I.GT.1.AND.LTU.EQ.1) CALL SLIDE
      1 IELE,NPR,LIST,MOVE,INTO,IDIAG,SKTT,SKXY,SKYX,SKYY,
      2 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
      DO 370 J=1,IELEX

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```

C      IELEJ=IELE(J)
      MJ=MAT(IELEJ)
      RHOJ=RHO(MJ,IELEJ)
      CPJ=CP(MJ,IELEJ)
      RCPJ=RHOJ*CPJ
      RKXJ=RKX(MJ,IELEJ)
      RKYJ=RKY(MJ,IELEJ)
C
      DO 210 K=1,NTPE
      DO 210 L=1,NTPE
      CPH(K,L)=0.0
      CMH(K,L)=0.0
210  CONTINUE
C
C      VOL=0.0
C
C      BEGIN QUADRATURE
C
      KEND=NUMQPT(1)
      DO 260 K=1,KEND
C
      XK=0.0
      YK=0.0
      TEMPK=0.0
      RJAC(1,1)=0.0
      RJAC(1,2)=0.0
      RJAC(2,1)=0.0
      RJAC(2,2)=0.0
C
      DO 220 L=1,NTPE
      NPL=NP(IELEJ,L)
      XK=XK+SF(1,L,K)*XORD(NPL)
      YK=YK+SF(1,L,K)*YORD(NPL)
      TEMPK=TEMPK+SF(1,L,K)*(UT(NPL)+UTI(NPL))/2.0
      RJAC(1,1)=RJAC(1,1)+SF(2,L,K)*XORD(NPL)
      RJAC(1,2)=RJAC(1,2)+SF(3,L,K)*XORD(NPL)
      RJAC(2,1)=RJAC(2,1)+SF(2,L,K)*YORD(NPL)
      RJAC(2,2)=RJAC(2,2)+SF(3,L,K)*YORD(NPL)
220  CONTINUE
C
      DETJ=RJAC(1,1)*RJAC(2,2)-RJAC(2,1)*RJAC(1,2)
C
      RJACI(1,1)=+RJAC(2,2)/DETI
      RJACI(1,2)=-RJAC(1,2)/DETI
      RJACI(2,1)=-RJAC(2,1)/DETI
      RJACI(2,2)=+RJAC(1,1)/DETI
C
      DV=DETI
      IF(IRZ.EQ.1) DV=XK*DETI
      VOL=VOL+WT(1,K)*DV
C
C      DO 235 L=1,NTPE
      DNDX(L)=RJACI(1,1)*SF(2,L,K)+RJACI(2,1)*SF(3,L,K)
      DNDY(L)=RJACI(1,2)*SF(2,L,K)+RJACI(2,2)*SF(3,L,K)
235  CONTINUE

```

```

C
DO 236 L=1,3
  L1=L
  L2=L+3
  DNQDX(L)=RJACI(1,1)*SF(7,L1,1)+RJACI(2,1)*SF(7,L2,1)
  DNQDY(L)=RJACI(1,2)*SF(7,L1,1)+RJACI(2,2)*SF(7,L2,1)
236 CONTINUE
C
C
  UXK=0.0
  UYK=0.0
  IF(ITEMP.EQ.1) GO TO 249
  IF(LAGEUL.EQ.1) GO TO 241
C
DO 240 L=1,NTPE
  NPL=NP(IELEJ,L)
  UXK=UXK+SF(1,L,K)*UX(NPL)
  UYK=UYK+SF(1,L,K)*UY(NPL)
240 CONTINUE
241 CONTINUE
C
C
C   CALCULATE VISCOUS HEATING
C
  IF(MOP.EQ.1) GO TO 249
  IF(IELEJ.GT.NELMC) GO TO 249
C
  EPSXX=0.0
  EPSYY=0.0
  EPSTH=0.0
  EPSXY=0.0
  OMGYX=0.0
C
DO 245 L=1,NUPE
  L1=NP(IELEJ,L)
  EPSXX=EPSXX+DNQDX(L)*UX(L1)
  EPSYY=EPSYY+DNQDY(L)*UY(L1)
  EPSXY=EPSXY+(DNQDX(L)*UY(L1)+DNQDY(L)*UX(L1))/2.0
  OMGYX=OMGYX+(DNQDY(L)*UX(L1)-DNQDX(L)*UY(L1))/2.0
245 CONTINUE
  OMGXY=-OMGYX
C
  IF(IRZ.EQ.1.AND.XK.EQ.0.0) EPSTH=EPSXX
  IF(IRZ.EQ.1.AND.XK.NE.0.0) EPSTH=UXK/XK
C
  GK=G(TEMPK,MI)
  IF(GK.LT.0.0) GO TO 247
C
C   CALCULATE STRESS RATES
C
  DXXDT=0.0
  DYYDT=0.0
  DXYDT=0.0
  DTHDT=0.0
C
DO 246 L=1,3
  DXXDT=DXXDT+DNQDX(L)*SIGXX(IELEJ,L)*UXK
  DYYDT=DYYDT+DNQDY(L)*SIGXX(IELEJ,L)*UYK
  DXYDT=DXYDT+DNQDX(L)*SIGYY(IELEJ,L)*UXK
  DYYDT=DYYDT+DNQDY(L)*SIGYY(IELEJ,L)*UYK
  DTHDT=DTHDT+DNQDX(L)*SIGXX(IELEJ,L)*UXK
  DTHDT=DTHDT+DNQDY(L)*SIGYY(IELEJ,L)*UYK

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1          +DNQDY(L)*SIGYY(IELEJ,L)*UYK
1          -2.0*SIGXY(IELEJ,L)*OMGY
DXYDT=DXYDT+DNQDX(L)*SIGXY(IELEJ,L)*UXK
1          +DNQDY(L)*SIGXY(IELEJ,L)*UYK
1          -SIGXX(IELEJ,L)*OMGY-SIGYY(IELEJ,L)*OMGYX
IF(IRZ.EQ.0) GO TO 246
DTHDT=DTHDT+DNQDX(L)*SIGTH(IELEJ,L)*UXK
1          +DNQDY(L)*SIGTH(IELEJ,L)*UYK
246 CONTINUE
C
C   CALCULATE PLASTIC STRAIN RATES
C
C   EPSXX=EPSXX-DXXDT/(2.0*GK)
C   EPSYY=EPSYY-DYYDT/(2.0*GK)
C   EPSXY=EPSXY-DXYDT/(2.0*GK)
C   EPSTH=EPSTH-DTHDT/(2.0*GK)
C
247 CONTINUE
C
C   CALCULATE EPSII
C
C   EPSII=(2.0/3.0)*(EPSXX**2+EPSYY**2+EPSTH**2+2.0*EPSXY**2)
C   EPSII=SQRT(EPSII)
C   CALL VISC(VS,VT,PENLTY,NPPE,EPSII,TEMPK,XK,YK,MJ)
C   Q=2.0*VS*(3.0/2.0)*(EPSII**2)
C
C
C   DO 248 L=1,NUPE
C   L1=NP(IELEJ,L)
C   FQ(L1)=FQ(L1)+WT(1,K)*SF(1,L,K)*Q*DV*DTIME
248 CONTINUE
C
249 CONTINUE
C
C   C=0.0
C   DO 250 L=1,NTPE
C   DO 250 M=1,NTPE
C   H=WT(1,K)*(DNDX(L)*RKXJ*DNDX(M)+DNDY(L)*RKYJ*DNDY(M))*DV
C   H=H+WT(1,K)*(RCPJ*(DNDX(M)*UXK+DNDY(M)*UYK))*SF(1,L,K)*DV
C   IF(ST.EQ.1.0) C=WT(1,K)*(SF(1,L,K)*RCPJ*SF(1,M,K))*DV
C
C   CPH(L,M)=CPH(L,M)+C+H*TH*DTIME
C   IF(ST.EQ.0.0) GO TO 250
C   CMH(L,M)=CMH(L,M)+C-H*(1.0-TH)*DTIME
C
250 CONTINUE
C
260 CONTINUE
C
C   END OF VOLUME QUADRATURE
C
C   IF(VOL.LE.0.0) GO TO 7003
C
C   SURFACE QUADRATURE
C
C   DO 290 K=1,3

```

```

      K1=2*K
      MIDSID=NP(IELEJ,K1)
      IF(CH(MIDSID).EQ.0.0.AND.TQ(MIDSID).EQ.0.0) GO TO 290
C
      LEND=NUMOPT(2)
      DO 280 L=1,LEND
      XL=0.0
      DXDXI=0.0
      DYDXI=0.0
      TQL=0.0
      CHL=CH(MIDSID)
C
      M1=K1-2
      DO 270 M=1,3
      M1=M1+1
      IF(M1.EQ.7) M1=1
      NPM=NP(IELEJ,M1)
C
      DXDXI=DXDXI+SF(6,M,L)*XORD(NPM)
      DYDXI=DYDXI+SF(6,M,L)*YORD(NPM)
      XL=XL+SF(5,M,L)*XORD(NPM)
      IF(TQ(MIDSID).NE.0.0) TQL=TQL+SF(5,M,L)*TQ(NPM)
C
270  CONTINUE
      DS=SQRT(DXDXI**2+DYDXI**2)
      IF(IRZ.EQ.1) DS=XL*DS
C
      M1=K1-2
      DO 280 M=1,3
      M1=M1+1
      IF(M1.EQ.7) M1=1
      NPM1=NP(IELEJ,M1)
C
      FQ(NPM1)=FQ(NPM1)+WT(2,L)*SF(5,M,L)*TQL*DS*DTIME
C
      N1=K1-2
      DO 280 N=1,3
      N1=N1+1
      IF(N1.EQ.7) N1=1
      NPN1=NP(IELEJ,N1)
C
      QL=WT(2,L)*SF(5,M,L)*CHL*SF(5,N,L)*DS
      CPH(M1,N1)=CPH(M1,N1)+QL*TH*DTIME
      FQ(NPM1)=FQ(NPM1)+QL*DTIME*TBC(NPN1)
      IF(ST.EQ.0.0) GO TO 280
      CMH(M1,N1)=CMH(M1,N1)-QL*(1.0-TH)*DTIME
C
280  CONTINUE
290  CONTINUE
C
      IF(ST.EQ.0) GO TO 331
C
      FORMULATION OF FQ=CMH*UT
C
C
      DO 330 K=1,NTPE
      NPK=NP(IELEJ,K)
      DO 330 L=1,NTPE
      NPL=NP(IELEJ,L)
      FQ(NPK)=FQ(NPK)+CMH(K,L)*UT(NPL)

```

```

330 CONTINUE
331 CONTINUE
C
  CALL STIFF(IELEJ,ITV)
C
  IF(LTU,EQ,0) GO TO 370
C
C
  CALL STIFF(IELEJ,ITV)
C
C
C
  PLACE IN LARGE K-MATRIX
C
  DO 366 K=1,NTPE
    K1=NPR(NP(IELEJ,K))
    DO 366 L=1,NTPE
      L1=NPR(NP(IELEJ,L))
      L2=IDIAG(2,K1)+(L1-K1)
      SKTT(L2)=SKTT(L2)+CPH(K,L)
366 CONTINUE
C
370 CONTINUE
C
C
C
  ALL ELEMENTS ACCOUNTED FOR IN CURRENT TAPE SEGMENT
C
C
C
  FORMULATION SOURCES, SINKS AND BOUNDARY CONDITIONS
C
  DO 385 J=1,ICOMP
    J1=LIST(J)
    J2=IDIAG(2,J)
C
    IF(CH(J1),EQ,0.0) FQ(J1)=FQ(J1)+TBC(J1)*DTIME
    IF(NPBC(J1),GT,0) GO TO 385
C
    IF(LTU,EQ,0) GO TO 384
    IF(SKBC,GT,1.0) SKBC=1.0/(SKTT(J2)*SKBC)
    SKTT(J2)=1.0/SKBC
384 CONTINUE
    FQ(J1)=TBC(J1)/SKBC
385 CONTINUE
C
  L-D-U DECOMPOSITION
C
  IF(LTU,EQ,0) GO TO 499
C
  DO 450 J=1,ICOMP
    J1=LIST(J)
    J2=IDIAG(2,J)
    IF(SKTT(J2),EQ,0.0) GO TO 7001
    SRTT=1.0/SKTT(J2)
    SKTT(J2)=SRTT
C
    IF(J,EQ,LISTX) GO TO 450
C
    KEND=LISTX-J
    IF(KEND,GT,(IB-1)) KEND=IB-1
C
    DO 449 K=1,KEND

```

```

      JPK=J+K
      K1=IDIAG(2,JPK)-K
      FAC=SRTT*SKTT(K1)
      SKTT(K1)=FAC
      IF(FAC.EQ.0) GO TO 449
      L1=IDIAG(2,J)
      L2=IDIAG(2,JPK)-K
C
      DO 448 L=1,KEND
      L1=L1+1
      L2=L2+1
      SKTT(L2)=SKTT(L2)-SKTT(L1)*FAC
448 CONTINUE
449 CONTINUE
450 CONTINUE
      WRITE(4) SKTT,SKXY,SKYX,SKYY,SKBC
C
499 CONTINUE
C
C
C
C
C
      DO 630 J=1,ICOMP
      J1=LIST(J)
      J2=IDIAG(2,J)
      KEND=LISTX-J
      IF(KEND.EQ.0) GO TO 630
      IF(KEND.GT.IB-1) KEND=IB-1
C
      DO 620 K=1,KEND
      JPK=J+K
      IF(JPK.GT.LISTX) GO TO 620
      K1=LIST(JPK)
      K2=IDIAG(2,JPK)-K
      FQ(K1)=FQ(K1)-SKTT(K2)*FQ(J1)
620 CONTINUE
C
630 CONTINUE
C
650 CONTINUE
C
      LTU=0
C
C
C
C
C
      BACK SUBSTITUTION
C
      IEND=NUMSEG(2)
      IF(IEND.EQ.0) IEND=1
      DO 690 I=1,IEND
C
      BACKSPACE 3
      BACKSPACE 4
      READ(3)
1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NPR,LIST,MOVE,INTO
      READ(4) SKTT,SKXY,SKYX,SKYY,SKBC
C

```

```

      DO 680 J=1,ICOMP
      J1=ICOMP+1-J
      J2=LIST(J1)
      FQJ2=FQ(J2)
      IF(J1.EQ.LISTX) GO TO 679
C
      KBGN=IDIAG(2,J1)+1
      J3=LISTX-J1
      IF(J3.GT.IB-1) J3=IB-1
      KEND=IDIAG(2,J1)+J3
C
      K1=J1
      DO 675 K=KBGN,KEND
      K1=K1+1
      K2=LIST(K1)
      FQJ2=FQJ2-SKTT(K)*FQ(K2)
675 CONTINUE
C
679 CONTINUE
      IDIAGJ=IDIAG(2,J1)
      FQ(J2)=FQJ2*SKTT(IDIAGJ)
680 CONTINUE
C
C
C
      BACKSPACE 3
      BACKSPACE 4
690 CONTINUE
C
C
C      CHANGE UTI ARRAY AND DETERMINE MAX DELT FOR CURRENT ITERATION
C
      DELT=0.0
      DO 708 I=1,NUMTP
      D=ABS(UTI(I)-FQ(I))
      IF(D.GT.DELT) DELT=D
      UTI(I)=FQ(I)
708 CONTINUE
C
C
C      ITERATION CHECK
C
      CALL SECOND(RTH)
      ITERT=ITERT+1
      IF(ITERT.EQ.1) WRITE(6,6)
      WRITE(6,5) INCR,ITERT,DELT,RTH
      IF(DELT.LE.DTCONV) GO TO 850
      IF(ITERT.GE.ITHAXT) GO TO 850
      IF(ITERT.LT.INCLTU(2)) GO TO 130
      INCLTU(2)=INCLTU(2)+INTLTU(2)
      LTU=1
      GO TO 130
C
C
C      850 CONTINUE
C
C
C      CHANGE UT ARRAY AND CALCULATE MAX DELT FOR CURRENT INCREMENT
C
      DELT=0.0

```



```

      DO 870 I=1,NUMTP
      D=ABS(UTI(I)-UT(I))
      IF(D.GT.DELT) DELT=D
      UT(I)=UTI(I)
870  CONTINUE
C
C      RETURN
C
C      ERROR MESSAGES
C
7001 WRITE(6,1) I,J,J1,J2,SKTT(J2)
      1 FORMAT(12H1 ERROR 7001 ,4I5,E15.5)
      STOP
7003 WRITE(6,2) J,IELEJ,VOL,(NP(IELEJ,I1),I1=1,NTPE)
      WRITE(6,3) (I1,XORD(I1),YORD(I1),I1=1,NUMTP)
      2 FORMAT(12H1 ERROR 7003, 2I5,E10.3,6I5)
      3 FORMAT(17,2E10.3)
      5 FORMAT(2I10,2E10.3)
      6 FORMAT(40H0      INCR      ITERT      DELT      CP TIME  ).
      STOP
C
C      END

```

```

SUBROUTINE SLIDE
1  (IELE,NPR,LIST,MOVE,INTO,IDIAG,SKXX,SKXY,SKYX,SKYY,
2  IDA,IB,IC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
  DIMENSION
1  IELE(IDI),NPR(IDB),LIST(IDJ),MOVE(IDJ),INTO(IDJ),IDIAG(2,IDJ)
C
  COMMON/C4/
1  KMAX(2),IBMAX(2),NGHAX(2),NUMSEG(2),
2  NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
C
  DIMENSION
1  SKXX(IDL),SKXY(IDL),SKYX(IDL),SKYY(IDL)
C
  COMMON/C8/
1  TIME,DTIME,DTMAX,DUMAX,
1  DELU,DELF,DELT,DELQ,
1  ITERC,ITERI,
1  DFCONV,DUCONV,DTCONV,DQCONV,
1  VECTL,CTEMP,
1  THETA,ALPHAT,TRANS,
1  INCPR,INCPU,INCPL,INTPR,INTPU,INTPL,
1  INLCU(2),INCLTU(2),INTLCU(2),INTLTU(2),
1  LCU,LTU,
1  MNI,ITMAXC,ITMAXT,
1  INCR,ITV,MOP,INTMP,LAGEUL,IRZ
C
C
  IF(ITV.EQ.-1) GO TO 500
C
C
  IEND=IDIAG(1,IEMPT+1)-1
  DO 230 I=1,IEND
    SKXX(I)=0.0
    SKXY(I)=0.0
    SKYX(I)=0.0
    SKYY(I)=0.0
230 CONTINUE
C
C
  DO 399 I=1,MOVEX
    II=INTO(I)
    IF(II.EQ.0) GO TO 400
    IM=MOVE(I)
C
    DO 350 J=1,MOVEX
      JI=INTO(J)
      IF(JI.EQ.0) GO TO 399
      JM=MOVE(J)
C
      IF(ABS(JM-IM).GT.(IB-1)) GO TO 350
C
      ITEST=+1
      IF(II.GT.JI) GO TO 250
      KI=IDIAG(1,II)+(JI-II)
      GO TO 260
250 CONTINUE
      ITEST=-1
      KI=IDIAG(1,JI)+(II-JI)
260 CONTINUE

```

```

C      IF(IM.GT.JM) GO TO 270
      KM=IDIAG(1,IM)+(JM-IM)
      GO TO 280
270  CONTINUE
      ITEST=ITEST*(-1)
      KM=IDIAG(1,JM)+(IM-JM)
280  CONTINUE
      IF(KH.EQ.KI) GO TO 350
C
C      SKXX(KI)=SKXX(KM)
      SKYY(KI)=SKYY(KM)
C
      IF(ITEST.LT.0) GO TO 300
      SKXY(KI)=SKXY(KM)
      SKYX(KI)=SKYX(KM)
      GO TO 340
C
300  CONTINUE
      SKXY(KI)=SKYX(KM)
      SKYX(KI)=SKXY(KM)
340  CONTINUE
C
      SKXX(KM)=0.0
      SKXY(KM)=0.0
      SKYY(KM)=0.0
      SKYX(KM)=0.0
350  CONTINUE
399  CONTINUE
400  CONTINUE
C
      GO TO 600
C
500  CONTINUE
C
C
C
C      NOTE, IN THIS SECTION SKXX IS EQUIVALENT TO SKTT
C
C      IEND=IDIAG(2,IEMPT+1) -1
      DO 530 I=1,IEND
      SKXX(I)=0.0
530  CONTINUE
C
      IBGN=IEMPT+2
      IEND=NBMAX(2)
      DO 545 I=IBGN,IEND
      JBGN=IDIAG(2,I)-I+1
      JEND=JBGN+IEMPT-1
      IF(I.GT.IBMAX(2)) JBGN=IDIAG(2,I)-IBMAX(2)+1
      IF(JBGN.GT.JEND) GO TO 546
C
      DO 540 J=JBGN,JEND
      SKXX(J)=0.0
540  CONTINUE
545  CONTINUE
546  CONTINUE
C

```

```

C
C      DO 599 I=1,MOVEX
      II=INTD(I)
      IF(II.EQ.0) GO TO 400
      IM=MOVE(I)
C
      DO 550 J=1,MOVEX
      JI=INTD(J)
      IF(JI.EQ.0) GO TO 599
      JM=MOVE(J)
      IF(IABS(JM-IM).GT.(IB-1)) GO TO 550
C
      KI=IDIAG(2,II)+(JI-II)
      KM=IDIAG(2,IM)+(JM-IM)
      IF(KM.EQ.KI) GO TO 550
      SKXX(KI)=SKXX(KM)
      SKXX(KM)=0.0
550 CONTINUE
599 CONTINUE
400 CONTINUE
C
C
C      RETURN
C
      END

```

```

SUBROUTINE PPP
1  (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
2  UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,MAT,
3  IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
C
C      DIMENSION
1  XORD(1DA),YORD(1DA),XBC(IDC),YBC(IDC),TBC(1DA),
2  CX(IDC),CY(IDC),CH(1DA),TX(IDC),TY(IDC),TQ(1DA),
3  COSXXP(IDC),NPBC(1DA),NP(IDF,IDE)
C
C      COMMON/C2/
1  XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
C      DIMENSION
1  UX(IDC),UY(IDC),UT(1DA),
2  PX(IDB),PY(IDB),IPQ(IDB,2),
3  FTX(IDC),FTY(IDC),FTQ(1DA),
4  SIGII(IDG),SIGXX(IDG,3),SIGYY(IDG,3),SIGXY(IDG,3),SIGTH(IDG,3),
5  MAT(IDF)
C
C      COMMON/C8/
1  TIME,DTIME,DTHAX,DUMAX,
1  DELU,DELF,DELT,DELO,
1  ITERC,ITERI,
1  DFCONV,DUCONV,DTCONV,DQCONV,
1  VECTL,CTEMP,
1  THETA,ALPHAT,TRANS,
1  INCPR,INCPU,INCPL,INTPR,INTPU,INTPL,
1  INLCU(2),INCLTU(2),INTLCU(2),INTLTU(2),
1  LCU,LTU,
1  MNI,ITHAXC,ITHAXT,
1  TNCR,ITV,MOP,INTEMP,LAGEUL,IRZ
C
C      DIMENSION
1  NP3(4,4),X(2),Y(2)
C
C      DATA NP3/5,4,2,2,3,5,4,6,4,6,6,1,2,4,2/
C
C      IF(INCR.NE.INCPR) GO TO 200
C
C      PRINTED OUTPUT
C
C      INCPR=INCPR+INTPR
C
C      WRITE(6,30) TIME,INCR
C
C
C      WRITE(6,2)
C      WRITE(6,3)DELU,DELF,DELT,DELO,ITERC,ITERI
C
C      WRITE(6,37)DTIME
C      WRITE(6,1) DUMAX
C
C      WRITE(6,15)
C      WRITE(6,14) (I,XORD(I),YORD(I),UX(I),UY(I),UT(I),FTX(I),FTY(I),
1  I=1,NUMTP)
C      IF(ITV.EQ.-1.AND.MOP.EQ.+1) GO TO 200
C      IF(NUMPP.EQ.0) GO TO 161

```

```

C      WRITE(6,7)
      DO 160 I=1,NUMPP
      I1=NUMVP+I
      WRITE(6,8) I1,PX(I),PY(I),IPQ(I,1),IPQ(I,2)
160 CONTINUE
161 CONTINUE
C
      WRITE(6,4)
      WRITE(6,5) (I,SIGII(I),(SIGXX(I,J),SIGYY(I,J),SIGXY(I,J),J=1,3),
      1 I=1,NELMC)
C
200 CONTINUE
C
C      PUNCHED OUTPUT
C
C
C      IF(INCR.NE.INCPU.OR.INTPU.LT.0) GO TO 205
C
      INCPU=INCPU+INTPU
C
      WRITE(7,9) INCR,TIME
      NUMNP=NUMVP
      IF(NUMTP.GT.NUMPP) NUMNP=NUMTP
      WRITE(7,10)(I,XORD(I),YORD(I),UX(I),UY(I),UT(I),I=1,NUMNP)
C
205 CONTINUE
C
C      PLOTTED OUTPUT
C
C
C      IF(INCR.NE.INCPL.OR.INTPL.LT.0) RETURN
      CALL MAP(XMIN,XMAX,YMIN,YMAX,0.0,1.0,0.0,1.0)
C
      INCPL=INCPL+INTPL
C
C
C
C
      NUMEL=NELMC
      IF(NELMT.GT.NELMC) NUMEL=NELMT
      DO 210 I=1,NUMEL
      I1=NP(I,1)
      I2=NP(I,2)
      I3=NP(I,3)
      I4=NP(I,4)
      I5=NP(I,5)
      I6=NP(I,6)
C
      CALL POINT(XORD(I1),YORD(I1))
      CALL VECTOR(XORD(I2),YORD(I2))
      CALL VECTOR(XORD(I3),YORD(I3))
      CALL VECTOR(XORD(I4),YORD(I4))
      CALL VECTOR(XORD(I5),YORD(I5))
      CALL VECTOR(XORD(I6),YORD(I6))
      CALL VECTOR(XORD(I1),YORD(I1))
210 CONTINUE
      CALL FRAME
212 CONTINUE

```

```

C
C
  IF(MOP,EQ,-1) GO TO 220
  IF(ITV,EQ,-1) GO TO 480
220 CONTINUE
C
C
C   PLOT VELOCITY FIELD
C
  VMAX=0.0
C
  DO 250 I=1,NUMVP
    IF(ABS(UX(I)).GT,VMAX) VMAX=ABS(UX(I))
    IF(ABS(UY(I)).GT,VMAX) VMAX=ABS(UY(I))
250 CONTINUE
C
  IF(VMAX,NE,0.0) GO TO 340
  WRITE(6,6)
  GO TO 479
340 CONTINUE
C
  DT=JECTL/VMAX
C
C
  DO 350 I=1,NUMVP
    CALL LINE(XORD(I),YORD(I),XORD(I)+UX(I)*DT,YORD(I)+UY(I)*DT)
350 CONTINUE
C
  CALL FRAME
C
C
479 IF(MOP,EQ,+1) GO TO 550
480 CONTINUE
C
C
C   PLOT ISOTHERMS
C
  DO 500 I=1,NELHT
    CMIN=UT(NP(I,1))
    CMAX=CMIN
C
    DO 420 J=2,6
C
      IF(UT(NP(I,J)).LT,CMIN) CMIN=UT(NP(I,J))
      IF(UT(NP(I,J)).GT,CMAX) CMAX=UT(NP(I,J))
420 CONTINUE
C
    CHK=(CMAX-CMIN)/CTEMP
    IF(CHK,GT,200.0) GO TO 7001
C
    INT=CMIN/CTEMP
    C=INT*CTEMP
C
430 CONTINUE
C
  DO 460 J=1,4
C
    J3=0
C

```

```

DO 450 K=1,3
J1=NP3(J,K)
J2=NP3(J,K+1)
J1=NP(I,J1)
J2=NP(I,J2)
SLOPE=UT(J2)-UT(J1)
IF(SLOPE.EQ.0) GO TO 440
PT=(C-UT(J1))/SLOPE
IF(PT.LT.0.OR.PT.GT.1.0) GO TO 450
GO TO 445
440 CONTINUE
IF(UT(J1).NE.C) GO TO 450
PT=J3
445 CONTINUE
J3=J3+1
X(J3)=XORD(J1)+PT*(XORD(J2)-XORD(J1))
Y(J3)=YORD(J1)+PT*(YORD(J2)-YORD(J1))
IF(J3.EQ.2) GO TO 451
450 CONTINUE
451 CONTINUE
C
C
IF(J3.NE.2) GO TO 460
CALL LINE(X(1),Y(1),X(2),Y(2))
460 CONTINUE
C
C=C+CTEMP
IF(C.LE.CMAX) GO TO 430
500 CONTINUE
C
CALL FRAME
C
550 CONTINUE
C
RETURN
C
7001 WRITE(6,11) CMAX,CMIN,CTEMP
STOP
C
C
C
C
FORMAT STATEMENTS
1 FORMAT(28H MAXIMUM DISPLACEMENT EQUALS ,E11.4 )
2 FORMAT(60H0 DELU DELF DELT DELQ ITERC I
1TERT )
3 FORMAT(4E10.3,2I10)
4 FORMAT(109H0 ELEM SIGII SIGXX1 SIGYY1 SIGXY1 SI
1GXX2 SIGYY2 SIGXY2 SIGXX3 SIGYY3 SIGXY3 )
5 FORMAT(I7,E12.5,9E10.3)
6 FORMAT(54H0 VMAX=0.0 IN PLOT ROUTINE, VELOCITY FIELD NOT PLOTTED )
7 FORMAT(//,53H NODAL POINT PRS QRS IPQ
1 ,/)
8 FORMAT(I12,2E15.6,I7,I4)
9 FORMAT(8H *****I10,E15.5, 33H*****
10 FORMAT(I5,2E10.3,3E18.10)
11 FORMAT(49H0 AUTO STOP, PLOT BLOW UP, CMAX,CMIN,CTEMP EQUAL :
1 3E10.3)
14 FORMAT(I7,2E10.3,5E15.5)
15 FORMAT(102H0 N.P. XORD YORD UX

```



```
      1UY          UT          FTX          FTY )
30 FORMAT(1H ,////,13H TIME EQUALS  ,E15.7,/,29H NUMBER OF INCREMENT
      1S EQUALS          ,I6 )
37 FORMAT(14H0 DTIME EQUALS  ,E10.3)
C
C      END
```

```

      SUBROUTINE SHAFAC
      1 (NPPE)
C
      COMMON/C6/
      1 SF(7,6,7),WT(2,7),NUMQPT(2),ISTRES(3)
C
      COMMON
      1 RJAC(2,2),RJACI(2,2),QPT(25,3)
C
C
C
C
      ISTRES(1)=5
      ISTRES(2)=6
      ISTRES(3)=7
      NUMQPT(1)=7
      NUMQPT(2)=3
C
      A1=0.059715871789770
      B1=0.470142064105115
      A2=0.797426985353087
      B2=0.101286507323456
C
      QPT(1,1)=1.0/3.0
      QPT(1,2)=1.0/3.0
      QPT(2,1)=A1
      QPT(2,2)=B1
      QPT(3,1)=B1
      QPT(3,2)=A1
      QPT(4,1)=B1
      QPT(4,2)=B1
      QPT(5,1)=B2
      QPT(5,2)=A2
      QPT(6,1)=B2
      QPT(6,2)=B2
      QPT(7,1)=A2
      QPT(7,2)=B2
C
      WT(1,1)=0.1125
      WT(1,2)=0.066197076394253
      WT(1,3)=WT(1,2)
      WT(1,4)=WT(1,2)
      WT(1,5)=0.062969590272413
      WT(1,6)=WT(1,5)
      WT(1,7)=WT(1,5)
C
C
C
      IEND=NUMQPT(1)
      DO 230 I=1,IEND
      QPT(I,3)=1.0-QPT(I,1)-QPT(I,2)
230 CONTINUE
C
C
C
      JEND=NUMQPT(1)
      DO 350 J=1,JEND
      DO 340 I=1,6
      SF(1,I,J)=SFN(QPT(J,1),QPT(J,2),QPT(J,3),I)

```

```

      SF(2,I,J)=SFNFI(QPT(J,1),QPT(J,2),QPT(J,3),I)
      SF(3,I,J)=SFNETA(QPT(J,1),QPT(J,2),QPT(J,3),I)
340  CONTINUE
      SF(4,I,J)=1.0
      IF(NPPE,EQ,1) GO TO 350
      DO 349 I=1,3
      SF(4,I,J)=SFNF(QPT(J,1),QPT(J,2),QPT(J,3),I)
349  CONTINUE
350  CONTINUE
C
C      CALCULATION SHAPE FACTOR DERIVATIVES FOR STRESS RATES
C
C
C
      I1=ISTRES(1)
      I2=ISTRES(2)
      I3=ISTRES(3)
C
      RJAC(1,1)=-QPT(I1,1)+QPT(I2,1)
      RJAC(1,2)=-QPT(I1,1)+QPT(I3,1)
      RJAC(2,1)=-QPT(I1,2)+QPT(I2,2)
      RJAC(2,2)=-QPT(I1,2)+QPT(I3,2)
C
C
      DETJ=RJAC(1,1)*RJAC(2,2)-RJAC(2,1)*RJAC(1,2)
C
      RJACI(1,1)=+RJAC(2,2)/DETJ
      RJACI(1,2)=-RJAC(1,2)/DETJ
      RJACI(2,1)=-RJAC(2,1)/DETJ
      RJACI(2,2)=+RJAC(1,1)/DETJ
C
      SF(7,1,1)=-RJACI(1,1)-RJACI(2,1)
      SF(7,2,1)=+RJACI(1,1)
      SF(7,3,1)=          +RJACI(2,1)
C
      SF(7,4,1)=-RJACI(1,2)-RJACI(2,2)
      SF(7,5,1)=+RJACI(1,2)
      SF(7,6,1)=          +RJACI(2,2)
C
C
C      FOR SURFACE INTEGRATION
C
      QPT(1,1)=(-SQRT(0.6)+1.0)/2.0
      QPT(1,3)=1.0-QPT(1,1)
      QPT(2,1)=0.5
      QPT(2,3)=0.5
      QPT(3,1)=(+SQRT(0.6)+1.0)/2.0
      QPT(3,3)=1.0-QPT(3,1)
C
      WT(2,1)=5.0/18.0
      WT(2,2)=8.0/18.0
      WT(2,3)=5.0/18.0
C
      JEND=NUMQPT(2)
      DO 410 J=1,JEND
      DO 410 I=1,3
      I1=I+4
      IF(I1,EQ,7) I1=1
C

```

```
      SF(S,I,J)=SFN(QPT(J,1),0.0,QPT(J,3),I1)
      SF(6,I,J)=SFNXI(QPT(J,1),0.0,QPT(J,3),I1)
C
C 410 CONTINUE
C
C
C      RETURN
C
C      END
```

```

      FUNCTION SFN(XI,ETA,ZETA,N)
C
C
      GO TO (201,202,203,204,205,206),N
C
201 SFN=(2.0*XI-1.0)*XI
    RETURN
202 SFN=4.0*ETA*XI
    RETURN
203 SFN=(2.0*ETA-1.0)*ETA
    RETURN
204 SFN=4.0*ETA*ZETA
    RETURN
205 SFN=(2.0*ZETA-1.0)*ZETA
    RETURN
206 SFN=4.0*XI*ZETA
    RETURN
C
C
      END
      FUNCTION SFNXI(XI,ETA,ZETA,N)
C
C
      GO TO (201,202,203,204,205,206),N
C
201 SFNXI=4.0*XI-1.0
    RETURN
202 SFNXI=4.0*ETA
    RETURN
203 SFNXI=0.0
    RETURN
204 SFNXI=-4.0*ETA
    RETURN
205 SFNXI=-4.0*ZETA+1.0
    RETURN
206 SFNXI=4.0*ZETA-4.0*XI
    RETURN
C
C
      END
      FUNCTION SFNETA(XI,ETA,ZETA,N)
C
C
      GO TO (201,202,203,204,205,206),N
C
201 SFNETA=0.0
    RETURN
202 SFNETA=4.0*XI
    RETURN
203 SFNETA=4.0*ETA-1.0
    RETURN
204 SFNETA=4.0*ZETA-4.0*ETA
    RETURN
205 SFNETA=-4.0*ZETA+1.0
    RETURN
206 SFNETA=-4.0*XI
    RETURN
C
      END

```

```
      FUNCTION SFNP(XI,ETA,ZETA,N)  
      GO TO (201,202,203),N  
201  SFNP=1.0-2.0*ZETA  
      RETURN  
202  SFNP=1.0-2.0*XI  
      RETURN  
203  SFNP=1.0-2.0*ETA  
      RETURN
```

```

FUNCTION GAMX(TEMPK,XK,YK,MJ)
  GAMX=0.0
  F=-0.74*TEMPK
  R=SQRT(XK**2+YK**2)
  GAMX=-F*XK/R
  RETURN
END
C
FUNCTION GAMY(TEMPK,XK,YK,MJ)
  GAMY=0.0
  F=-0.74*TEMPK
  R=SQRT(XK**2+YK**2)
  GAMY=-F*YK/R
  RETURN
END
C
FUNCTION G(TEMPK,MI)
  G=-1.0
  RETURN
END
C
SUBROUTINE VISC(VS,VT,PENLTY,NPPE,EPSII,TEMPK,XK,YK,MJ)
  VS=3.0
  VT=3.0
  PENLTY=0.0
  IF(NPPE.EQ.0) PENLTY=1000.0*VS
  RETURN
END
C
SUBROUTINE HSHADJ
  RETURN
END
SUBROUTINE BNDRY
  RETURN
END
C
SUBROUTINE BNDRYC
  RETURN
END
C
SUBROUTINE BNDRYT
  RETURN
END
C
FUNCTION RHO(MJ,IELEJ)
  RHO=.370E+04
  RETURN
END
C
FUNCTION CP(MJ,IELEJ)
  CP=1.2E+03
  RETURN
END
C
FUNCTION RKX(MJ,IELEJ)
  RKX=6.66
  RETURN
END
C

```

```
FUNCTION RKY(MJ,IELEJ)
  RKY=6.66
  RETURN
END
C
SUBROUTINE STIFF(IELEJ,ITV)
  RETURN
END
```